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THE BLUE CYANÆA.

BY PHILIP HENRY GOSSE, F.R.S.

(With a Coloured Plate.)

Of all the varied forms of strange life which the prolific sea carries in her bosom, few are more calculated to attract and rivet interested attention than the *Medusæ*. Globose forms of translucent jelly, clear as crystal, or bearing alternate bands of frosted surface, like a lamp-globe of clear and ground glass commingled, colourless as the water which bears them, or dyed with the loveliest hues, moulded with the most elegant symmetry—they appear and vanish, now urging their solitary course with an unintelligible energy, now associated in immense groups, rising and falling helplessly on the lazy swell of the summer sea, now eluding the most diligent search. Whence they come, whither they go, why they congregate, why they separate, we know not. We land from the steamer in one of our western watering-places, and as we bustle about the pier, watching our luggage, we cannot help seeing that the surface of the little harbour is thronged with the elegant jelly-fishes. The oars of the busy boatmen push them about, or cut them through unheeded; they rotate with undignified agility in the swirl of the steamer's screw; they repose in motionless majesty between the piles of the wharf, where, as we look down perpendicularly upon them in the shadowed water, every line and every tint is discerned to advantage, and we wonder at their beauty. Or we take our stand on some rocky headland, and gazing into the transparent depth, see far below the surface a great sphere of painted glass, vigorously yet heavily making way by alternate pump-like expansions and contractions, and dragging in its oblique wake a tangled crowd of cords. Or, in the dazzling twinkling haze of an August noon, we take a pull in a boat a mile or two off shore, and, taking our station in the bow, break the glistening surface of the mirrory sea with re-

peated dips of a muslin ring-net, obtaining large material for wonder and admiration. Yonder, in the unbroken clearness, floats a globe of heavenly blue; carefully the net is lowered beneath it, and as we lift it out of water we marvel at its weight. It lies a shapeless mass of coloured jelly in the bottom of the strained bag; but we turn it out into the bucket of sea-water, drawn fresh and pure to receive it, and then, as it turns over, and gives two or three pumping strokes to prove its powers, we see that it is uninjured; and now, away to shore, that we may examine our prize at leisure.

On putting the creature into an ample glass tank, we discover that we have before us an object of singular beauty. It is of a somewhat mitre-like form, or that of two-thirds of a globe, with a slight tendency to constriction around the upper third, the diameter being about five inches, and the height about three and a-half.* On turning over the pages of Eschscholtz's *System der Acalephen*, the best work extant on these creatures, we have no difficulty in determining our captive to belong to the interesting and highly-organized genus *Cyanœa*.

This genus was established by Peron for such discoid Medusæ as possess tentacle threads and sac-formed appendages to the stomach, and whose tentacles are not arranged around the edge of the disk, as in the genera *Pelagia* and *Chrysaora*, but spring in bundles from the inferior area of the disk; while there are on the outer edge of the disk vascular processes of the digestive cavity. The sac-formed appendages are sixteen in number,† on the circumference of the stomach, of which eight broader alternate with as many narrower. These accessory sacs or pouches are formed on a quite peculiar model, for we meet with them in no other genus of discoid Medusæ: their under skin having numerous cross-foldings, lying closely side by side, which, as they appear united at both ends, form peculiar small sac-formed extensions of this skin. Within the cross-foldings there is a row of toothed vesicles, which probably secrete a fluid accessory to digestion—a gastric juice. The vesicles are so arranged that they constitute excentric rows. Though the accessory pouches appear on their exterior circumference as if cut off or closed up, owing to the last cross-fold, yet this is only apparent, for their cavity has many expansions at the border of the disk. In the first place there are sixteen processes of the pouches, whose bases are in connection with the outer angles of two pouches, immediately

* The figure in the annexed plate, which was drawn from a specimen in full health and vigour, represents the animal reduced to about half the natural size.

† Thirty-two, according to Eschscholtz (*Op. Cit.*, p. 67), sixteen broad and as many narrow; but his figures represent only half these numbers, and I can find no more in the specimens which I have examined. I suspect a verbal error in his text.

opposite the division between them. Each of these processes is closer to its neighbour on one side than to that on the other, owing to the alternate variation in the width of the pouches on which they are seated. Their form is much longer than wide, and they, too, are furnished with folds, which, however, run lengthwise, and contain rows of vesicles. From these processes the digestive cavity now expands on all sides, sending out ramifications to the margin of the disk.

The tentacles, which are slender threads of no great length, spring not from the edge of the disk, but partly from the outer margin of the pouches, and partly from that side of each process which faces its more remote neighbour.

Close around the orifice of the stomach, which occupies the centre of the inferior surface, arise four lips, which are thrown into strong longitudinal folds, but which, when extended, are seen to have a flat three-sided form. They do not cohere together so as to form a foot-stalk.

In full-grown individuals the germs or ova are apt to fall by their own weight out of the ovaries, and hang down in strings or masses between the folded lips.

There is enough in this diagnosis of the genus, which I have freely transferred from Eschscholtz, to enable us to identify our elegant specimen as a *Cyanœa*, while yet in several particulars there is a divergence. The pouches are very nearly of equal width; at least, though they vary slightly in this respect, there is no noticeable alternation of a wide and a narrow one in regular succession. Again, the diverging processes are but eight in number, of a semi-elliptic figure, each seated half on two contiguous pouches, its median line corresponding to the line that divides them. Possibly, however, this semi-ellipse may be resolvable into *two* processes placed side by side in close contact; the line of junction (if of two), or the centre (if of one), being immediately opposite the curious little eye-sac, which I will presently describe.

As to the species, I have some difficulty. Eschscholtz has described but four: of these, the *C. ferruginea*, of Behring's Straits, and the *C. rosea*, of the Australian seas, may be set aside at once: there remain *C. capillata* and *C. Lamarckii* of our own coasts. The former of these, with its great tawny disk and lips, its stomach-pouches alternating in width, but about equal sided, and their long, narrow, parallel-sided, obliquely truncate processes, may also be dismissed. There remains, therefore, but *C. Lamarckii*, and with this our captive tolerably well agrees. The Prussian zoologist describes this species as having its disk covered with indistinct large flat grains, and of a whitish tint, but so faint as to be hardly perceptible. The margin has eight deep incisions, which separate as many broad

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three-sided flaps, a little bowed at the sides, and rounded at the end, where there is a slit for the supposed visual organ. The inferior skin of the stomach, and of its folded pouches, is of a transparent grey hue, but the inner surface of these parts, which is inclosed in the disk-mass is blue; and this, sinking in many places into the disk-mass by the contact of two coloured surfaces, gives origin to many blue lines. "Thus we perceive over the centrally-placed stomach a somewhat indented blue circle, and within the same a net of such skin-folds. From this circle proceed sixteen rays,* each of which lies immediately over the median line of one of the accessory pouches." In the specimen which I have figured, when viewed vertically from above, the whole area bounded by the outer edge of the pouches is of a rich translucent blue, of which the central portion, corresponding to the circular orifice of the mouth, is of the deepest intensity; while from this deeper part *twenty-four* slender bands of *whitish* radiate to the well-defined edge of the lighter blue, one proceeding to each of the eight principal incisions, and one towards a point some distance on each side of the visual organ. The lips or furbelows are short, folded strongly, and overlapped at the edges. The tentacles in Eschscholtz's specimen were white. Lamarck describes them as blue; mine agree with the latter, for they are of the same full clear blue as the disk. These organs, originating as before described, constitute eight groups of about forty tentacles each, which are graduated in length, the largest being in the centre of the group, the shortest at the extreme sides. The actual length, however, varies considerably, from an inch to six inches or more, at the pleasure of the animal, as they are very contractile and extensile. As usual, these organs are roughened by the presence of tubercles, which are densely-crowded groups of *cnidæ*, or thread-capsules, twenty to fifty in each, so closely set as to be in actual contact. The cnidæ are mostly of a short oval form, from 1-1800th to 1-10,000th of an inch in length, each containing a chamber occupying about half of its volume. The ecthoreum or venomous thread is of great length; I traced one to 1-18th of an inch, or a hundred times the length of its cnida. The cnidæ of the furbelows are much larger, some reaching to 1-1000th of an inch, with a linear chamber; they are scattered throughout the gelatinous expansion of these appendages, but are mostly aggregated at the edges, which are thence slightly thickened. The stomach-pouches are somewhat hollowed in the outline of their exterior border, so that their angles project.

A very conspicuous feature in this Medusa is the presence of great arched folds into which the outline of the disk is thrown. These are sixteen in number, eight wide and tall,

* Also said to be blue ("*radiis sedecim cyaneis*") in the specific character.

corresponding to the deeper incisions of the margin, eight narrower and lower, corresponding to the incised points of the flaps. The folds of gelatinous membrane which constitute these arches are very complex, and both sets are the seats of elaborate ramifications of the canals that proceed from the digestive cavity, and carry water, charged with nutrient particles and with oxygen for respiration, to the exterior of the system. Up each side of the greater arches the ramification takes the form of a succession of loops seated on the marginal canal; whereas, to the summit of each smaller arch proceeds a straight canal, which sends off from each side a series of curved cœcal processes, like the beards of an elegant feather. The point of the canal which would represent the quill of this feather merges into the singular little organ which we must consider as performing the function of an eye.

These organs are extremely interesting in their structure, and are worthy of more attention than is usually bestowed upon them. They occur in certain genera of Medusæ, which in other respects have a higher organization, and are always protected with these hoods of membrane, whence such genera have been grouped together under the title of *Steganophthalmata*, or Covered-eyed; while other zoologists have associated them with the family *Lucernariadæ*, as an order named *Lucernaridæ*.*

In each genus the organ consists of a round or ovate body, of an opaque red or yellow colour, pendulous from the summit of the protecting hood, or arched fold of membrane at the edge of the disk. It is connected with the disk by a slender footstalk, into which one of the canals passes as already described; the interior of this pedicel being delicately ciliated.

* Professor Greene's *Manual of the Cœlenterata*. Surely a most objectionable designation; for the termination *idæ*, changed to *adæ*, when the noun is of the first declension, or ends in *os purum* (equivalent to *ius*, *eus*, etc., in Latinized forms)—the Greek patronymic—has been accepted by zoologists as the distinction of *family* rank; and to form an *ordinal* appellation, including the family, on the same model, is most irregular, and only productive of confusion. Indeed, the form *Lucernaridæ* is incorrect, since *Lucernaria* being of the first declension, the only patronymic that can be formed of it is *Lucernariadæ*. I will use this opportunity of adding a word on the usage of naturalists in constructing family designations. If the rule I have just mentioned is the true one, such forms as *Pelagidæ*, *Oculinidæ*, *Colidæ*, *Rhizostomidæ*, are incorrect, and should be rejected; the first two should be *Pelagiadæ* and *Oculinadæ*, the terminal *a* of the component noun being changed into *adæ*; the third *Coliadæ*, because Colius (= *os purum*) of the second declension makes its patronymic in *adæ*; whereas the fourth should be *Rhizostomatidæ*, since *stoma* is not of the first but of the third declension, and forms its patronymic from the genitive. Some naturalists, who are competent scholars, form the termination always in *idæ*, believing the rule to have reference to εἶδος, resemblance. I have, however, the best authority for stating that at the first proposal and adoption of the termination *idæ* for zoological families, at a meeting of the Zoological Club, composed of the late Mr. Vigors, Professor Bell, and two or three other eminent naturalists, whose names I cannot now with certainty mention, the construction of the Greek patronymic was the rule accepted, and that a compound of εἶδος was not even thought of.

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The ovate organ, so exquisitely fashioned, so liberally furnished, and so carefully shielded, presents a beautiful appearance when viewed as an opaque object under a strong light, reflecting a fine yellow colour, and displaying the regularly-shaped extremities of transparent and colourless prisms with which it is filled. As long ago as 1816, Gäde* defined these prisms, and some years afterwards Rosenthal† perceived them to be hard corpuscles, and supposed them, *since they did not effervesce with acids*, to be atoms of silicious earth or sand.

Still later (in 1834) Ehrenberg submitted these marginal organs of the Medusæ to an elaborate examination, the results of which he gave as follows:—"The hard bodies are most regularly crystallized, water-clear forms, of the crystallization of the quartz-system; namely, six-sided, short, sometimes nearly globular columns, with a doubly-three-sided or six-sided point. Often they are regularly equal-sided, or longish six-sided tables, like those formed of carbonate of lime; not seldom they are long six-sided rods, with unequal flat points; but always quite distinctly, almost regularly, crystalliform." The learned professor then proceeds to tell us how he poured sulphuric acid on the whole sac, with no perceptible result; how then he crushed down several sacs together, and heated the mass with the same acid, and how the crystals were instantly lost amidst the formation of bubbles. He concludes, therefore, that the prisms are veritable crystals effervescing with acids, and probably consist of carbonate of lime, similar to those which he had previously discovered in vertebrate animals, in connection with the nervous centres.‡

Thus the inorganic earthy crystalline nature of these bodies appeared to be established; and in the latest work on the anatomy of these creatures—Professor Greene's *Manual of the Cœlenterata*—the term "lithocyst" is used for the prism-filled sac, and the prisms themselves are described as "crystalline." Yet I am bold to affirm that this is an error. As long ago as 1856 I stated, on the ground of my own examinations, a different conclusion. "It does not appear that these bodies are silicious, ... or that they are crystals of earthy matter at all, but rather that they are composed of hard transparent organic tissue, analogous to the crystalline lens in vertebrate animals. When treated with *liquor potassæ* they speedily became amorphous and dissolved into a turbid fluid. Another lot, immersed in nitric acid, dissolved in like manner, acquiring a slight tinge of green during the process. Not the slightest effervescence or disturbance was visible by the most careful watching under either treatment."§

* *Anat. u. Phys. der Medusen*, pp. 18, 28. † *Zeitsch. f. Phys.*, 1825, p. 326.
‡ *Müller's Archiv*, 1834, p. 574. § *Tenby*, p. 174.

Since the publication of these observations, I have had additional proof of the non-earthy character of the prisms; for having mounted some, carefully cleansed, on several glass slides, and covered them with plates of thin glass, for future microscopic observation, I found, after some months, that they had wholly disappeared, leaving scarcely a trace of their existence, though exposed only to the atmosphere, and this admitted only under the edges of the plates of glass. If they had been earthy crystals, it is manifest that they would have remained unchanged both by the atmosphere and by potass.

The specimen whose portrait accompanies this little memoir lived for two or three days only, in a glass vase of sea-water. Generally I have not been able to preserve these forms in health for a longer period; though a fine specimen of *Chrysaora cyclonota*, whose history I have given elsewhere,* lived under similar circumstances about three weeks. A very gorgeous object was the *Cyanœa* in captivity. The whole umbrella was of a fine rich blue, possessing a sapphirine brilliance and transparency, especially when the slanting rays of the setting sun shone horizontally through the mass, as it floated in its glass prison on our drawing-room table. This hue was deepest where the substance of the disk was thickest, while at the surface and edges it melted off into colourlessness. Yet the lower integument or sub-umbrella, being of a far deeper colour, the form of the inner dome, viewed horizontally, was quite broadly defined from the hue of the mass, and seemed like a solid hemisphere of glass within the mitre, of a blue so intense that the sun's rays could scarcely struggle through it. In this the vault-like clefts were fashioned, reminding us of those beautiful paper-weights, in which some exquisitely folded pattern is seen within a perisphere of smooth clear glass.

It was interesting to observe that by lamplight the hue was very different. As I have often noticed that flowers which by daylight are almost purely blue, show by candlelight a prominent red element, before unrecognized, so this fine Medusa became of a fine imperial purple. I suppose the explanation is, that the blue ray is more weakly perceptible by artificial light, and is, therefore, overpowered by the red ray, though this may exist in the compound tint in actually a less ratio.

I could not detect any stinging property in the tentacles when touched by the hand. Its congener, *C. capillata*, is described as so formidable as to be the terror of bathers; and Edward Forbes has given us a graphic description of an unfortunate swimmer writhing, terrified and tortured, in the clinging grasp of its slimy threads. Much may depend on the varying susceptibility of the human skin to the poison in different per-

* *Devonshire Coast*, p. 363, *et seq.*

sons. Only a day or two ago I was engaged in capturing some lovely specimens of *Chrysaora;* a lady of my party, in lifting one, complained of being stung, while I lifted them without the slightest sense of such a phenomenon. So it is with some Anemones, the tangled snake-like locks of *Anthea cereus* may be handled by a man with impunity, while the tenderer skin of women and children smarts and reddens with the contact.*

* The subject of the poison-apparatus in a kindred group of animals I have treated in considerable detail in my *Actinologia Britannica* (Introd. pp. xxii.—xl.) I hope it may not be considered out of place if I here cite some observations of an American zoologist, confirming some of the most important of my conclusions, and adding other information of much value. Professor Henry James Clarke, of Harvard University, Cambridge, Mass., in a very able article, entitled "Lucernaria, the Cœnotype of Acalephæ," describes the cnidæ of this organism in the following terms:—

"The nettling organs or lasso cells, which crowd the globular tips of the tentacles, are of two kinds, and both are imbedded in the intercellular substance which fills the spaces between the columnar cells of the outer wall. One kind consists of an oval, thick-walled vesicle about 1-2000th of an inch long, or a little less, one end of which is introverted and projects in the form of a stout hollow shaft along the axis of the cell, about four-fifths of its length, and then, rather suddenly thinning into a slender thread, which is also hollow, it bends upon itself, returns nearly to the aperture of the cell, and, pressing closely against the inner face of the cell-wall, it forms a close coil, which terminates at the end opposite the mouth of the introversion. When the coil of thread is ejected, which is accomplished by sliding through the hollow axial shaft, which, in its turn, retroverts also, just as the finger of a glove is turned inside out, the whole aspect of the apparatus is changed. The oval cell is considerably diminished in size, and from its aperture the enormously enlarged hollow shaft projects in a straight line; the half of the shaft next the cell is cylindrical, and half as broad as the latter, with a slight expansion where it joins the mouth of the cell; the distal half abruptly expands into an oval form, half again broader than the cylindrical portion, and rapidly tapers into a smooth trihedral, twisted thread. The oval part of the shaft is endowed with three equidistant spiral rows of setæ, which number about a dozen in each row. The setæ are comparatively large, and in length equal two-thirds the broadest diameter of that part of the shaft from whence they project. Each row makes but one turn above the shaft, and terminates as if in continuation of the angles of the trihedral thread. There is not the least trace of setæ or projections of any kind upon the trihedral thread, but it continues, with a very gradual taper, perfectly smooth to the blunt termination. The angles of the thread appear, at first glance, as if they might be spiral rows of setæ; but a most careful and prolonged examination with one of Spencer's $\frac{1}{4}$-inch objectives convinces me that they are truly the angles of a twisted trihedral filament. The extent of the thread is from twenty to twenty-four times the length of the cell. The other kind of nettling cell is much more simple in structure, but yet more remarkable. The introverted shaft is very slender, in fact no larger than the rest of the thread. It does not project into the axis of the cylindrico-oval cell, but presses close to the side of the latter, and extends four-fifths of the way to its opposite end, and then, bending abruptly upon itself, the thread passes with a long curved sweep nearly to the aperture of the cell, from whence it again returns with another long sweep, which is repeated eight to ten times, until the inner face of the cell-wall is lined by a close coil which winds lengthwise instead of transversely, as it does in the other kind first described. When extended the thread is from twelve to fourteen times the length of the cell. It offers not the least sign of appendages of any kind, but is simply a smooth round filament of uniform thickness throughout, except at the end, where it tapers slightly and terminates in a blunt tip. The cell itself, when retroverted, is sensibly diminished in size, and narrows rapidly into the prolonged filamentary portion. It would

FALLING STARS AND METEORITES.

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From the earliest times—long before men had any idea of the calculations of astronomy, of the difference between planets and fixed stars, or of the vast distance of the nearest star not only from the earth, but from any part of the solar system—the singular phenomena of falling stars had been noticed, and had connected themselves with feelings that will probably never be entirely eradicated from the minds of men. Thus in the same ancient Jewish history that tells us "the sun stood still, and the moon stayed," in order that Joshua might destroy a few more of his fleeing enemies, we read also, "the stars in their courses fought against Sisera." Both these expressions are probably intended as no more than oriental pleonasms, but they indicate strongly the unalterable egotism of man, who will to the end of time regard himself and his affairs as the ultimate object of divine care.

When, therefore, on the tenth of August last, the usual annual shower of Nature's rockets was seen in the atmosphere —this storm of silent flashes and darts of light, mysteriously shooting from one point of the heavens towards another point, some with bright trails of light, some as fiery balls, some darts and arrows of light, and not a few ending as the rocket with an additional shower of sparks—many, perhaps, who were unaware of the natural history of these objects may have fancied that some extraordinary crisis was about to take place in American politics, or that Europe was about to be convulsed by the refusal of Russia to treat the Poles as anything but wild beasts. For a very long time, however, the corresponding date, and also the 12th November, and several other days in the year, have been remarkable for an exhibition of the same kind without political consequences.

Kings have been born and died; revolutions have been commenced and carried out in human affairs; battles have been won and lost, but the day of the shower of falling stars has not much altered, though the clear sky has sometimes favoured, whilst at other times the clouds have concealed, the mysterious operations of nature.*

seem to be perfectly incontestable that, as the cell diminishes in size with the expulsion of the thread, it forms the propelling power, and, by the contraction of its wall, forces its contents outward."—*American Journal of Science*, May, 1863.

* It is a remarkable fact that in some very ancient records the date assigned to the phenomenon is many days earlier, even so early as the 25th July. In Thessaly there is a tradition that the heavens open and lights appear on the festival of the Transfiguration (6th Aug.) The reason is obvious. The civil time we

That the great crowd of falling stars is seen chiefly on the two occasions whose dates have been just given, is unquestionable; but they are also numerous on the nights preceding and following the principal ones, and they are visible, though less frequently, during every fine clear night throughout the year.

Few subjects are more interesting than the inquiry into the meaning of these appearances, and they have from time to time been noticed in these pages. Within the last few years there has been an enormous quantity of material collected, both concerning the actual history of showers of stones and meteors, and the details of remarkable examples. Few who have not followed the course of inquiry are aware how much material exists, how frequent and portentous the larger instances have been, and how very much positive proof there exists of the materiality of some, at least, of the phenomena, in the existence of many hundred well-authenticated specimens of fallen stones in several of the principal museums of Europe. A few accounts of remarkable cases will be both interesting and useful in preparing the reader for a consideration of the explanations that have been offered for the various facts recorded.

And, first of all, with regard to the number of these appearances. In the present year, at Cambridge, nearly a hundred meteors were counted by a single observer in one part of the heavens between 10 P.M. and 1 A.M. They were most abundant towards midnight. On another occasion, some years since, 565 were counted on the corresponding night, but this was by six observers, each taking a part of the heavens, and continuing the observations for five hours, from 10 P.M. to 3 A.M. There has hardly been an occasion, when the sky was clear, on which a very large number of these curious appearances have not been seen on the nights now known to be rich in them. On other nights they are occasional, but on these they succeed each other rapidly. It is not reasonable to suppose that they are limited to the hours of darkness, and thus it becomes probable that uninterruptedly, during certain days in the year, and at all other times with less regularity, and to a smaller extent, these lively messengers are constantly communicating between the world and the outer space; these visible messages along the telegraph of space are always reminding us that our earth is not wandering in a solitary path, but is surrounded by myriads of small fragments of matter, made visible when they pass through our atmosphere, or when we pass near them in their course.

There are two distinct classes of phenomena connected with

use does not correspond exactly with sidereal time, and the phenomena thus appear to occur gradually later and later in the year, though the intervals between their recurrence is really the same.

the subject of meteors. These are, first, the phenomena of light —the falling stars—as seen in the atmosphere; and secondly, the fallen bodies themselves, whether called meteorites, aërolites, fire-balls, bolitos, or thunderbolts—the fragments of foreign matter now and then seen to fall on the earth from the sky, but more frequently found near the surface, and identified by their peculiar mineral characteristics.

The meteors are of various kinds, so various that it is almost impossible to bring together within a limited space such an account of different records as shall give even a faint idea of the appearances described by those who have seen them. Limiting ourselves to the remarks of astronomers, and persons fully accustomed to observe and describe what they see, we yet find accounts as strange as if they were dreams of sick men.

The vast majority of the strange lights seen in the heavens are well described by the expression, Falling or shooting star. Suddenly a star, or what appears a star, shoots rapidly from one point in the heavens to another, or seems to fall downwards towards the earth, and disappear. Of such phenomena, whatever they are, it is not too much to say that thousands sometimes take place within twenty-four hours; that on special occasions this number may be multiplied many fold; that they are common even at all other times, and that, in fact, they are as little exceptional as clouds. It is impossible to identify and measure any particular one, for they are too frequent and too much alike. They are seen from every part of the earth's surface almost every fine night throughout the year, in every quarter of the heavens, and there cannot be the smallest reason for supposing that they do not occur by day as well by night, in foul weather as well as fair.

Of these ordinary shooting-stars, special observations are made at certain dates, because they are then most numerous and most definite. At such times, as we have seen, they are counted by the hundred, often by hundreds in the hour, in all the principal observatories, and by many private individuals. On such occasions they appear, most of them, but not all, to proceed from near one point in the heavens, and disappear in another. These points are generally the same.

Of the size of these meteors it is impossible to give any correct idea. It is usual to compare them to the stars, and speak of them as resembling stars of the first to the third magnitude. It seems quite impossible to judge even relatively of their actual dimensions by observations of this kind, even when for any reason it has been possible to estimate their height.*

* An ingenious and very simple instrument for estimating the altitude of these bodies was described in the INTELLECTUAL OBSERVER, vol. iii., p. 165.

Passing on now to the more remarkable and rarer meteors we find statements of the most singular and even contradictory nature. There is much that is interesting and instructive in these accounts, though when forwarded by observers not accustomed to astronomical descriptions, they require a certain amount of correction.

The simplest complications of an ordinary shooting-star are an apparent curvature, a serpentine course, or an apparent interval of repose in the course; a distinct line of light or train left behind in the sky, and a bursting of the star before it disappears, leaving behind a multitude of small stars precisely resembling an exploded rocket. All these are common. The rarer appearances will be noticed presently.

The duration of the phenomenon is another matter also very interesting in certain cases. While ordinary meteors are over almost before one has time to be sure of their existence, and note their size and direction, others move slowly. Trains remaining visible for several tenths of a second, for one or even two seconds, are exceptional, but not very rare. Now and then, however, the meteor lasts for a minute. Much more remarkable cases are, however, recorded. Thus, on the 7th January, 1856, at 4·50 P.M., a fire-ball appeared in the sky in the South of England, being seen at various places between Wiltshire and the east of Kent. The sky was clear, and the fire-ball appeared to burst out from the sky as a brilliant globe of light. It remained visible everywhere for more than ten minutes before it finally disappeared. In Wiltshire it was seen for twenty minutes, at Brighton for fifteen minutes, at Sevenoaks for ten minutes, and at Blackheath for the same time. Its size was estimated at four times the diameter of Jupiter. In most places it suddenly appeared from the clear sky, but at Blackheath it emerged from, and was lost behind clouds. This very remarkable meteor is one of the best and most distinctly recorded of those which have been seen at great distances apart, and which, being seen for some time, could be clearly identified.

Many of the meteors appear coloured, and the colours are very varied. Bright emerald blue, intense blue, orange, greenish and red, have all been described, and, as may be supposed, there are abundant shades of each. Upwards of a thousand coloured shooting-stars were distinctly recorded as observed in England in the sixteen years from 1840 to 1855, and records of about a thousand have also been collected from China. Of the former, upwards of half were yellowish red, and a third whitish blue. Of the latter, about one-third were pure blue, a sixth pure yellow, and about the same number pure red. Of larger meteors or globes, it has been recorded that about 700

probably fall annually on the earth. These move more slowly than the smaller stars, and they exhibit several colours in their course, but are generally blue towards the horizon. Many of them change colour, and others suddenly burst into a multitude of small stars, or into a kind of vaporous cloud of peculiar tints. Some emit coloured light vivid enough to redden or colour the surface of the earth. It is a remarkable fact, often noticed, that these meteors are unusually bright when seen through an aurora borealis.

The great majority of meteors appear to proceed from some point in the East, but this may be owing to the relation between the earth's motion in space and that of the meteors themselves.

The heights of meteors that have been subject to actual calculation lie apparently for the most part between sixteen and one hundred and forty miles, though some reach two hundred, and some as much as four hundred miles, while some appear to be not more than four miles from the surface at the commencement of their course. Their velocity is less accurately known, but has been estimated as generally double that of the earth in its orbit. Herschel, however, assigns velocities varying from eighteen to thirty-six miles per second for ordinary meteors, and states that some appear to travel at the rate of ninety miles per second. The earth's motion in its orbit is between nine and ten miles per second.

The passage of meteors is sometimes, though rarely, accompanied by noise, and in that case it is probable that some solid body explodes in the air and falls to the earth. Falling stars are thus connected with these remarkable aërolites, or meteoric stones, specimens of which are to be found in several public museums.

As one of the most remarkable and complete accounts of the phenomena of meteorites that has been placed on record, I add an abstract of an account published in the *American Journal of Science*, vols. xxv. and xxvi., of appearances observed over a wide area on the night of the 12th and early morning of the 13th of November, 1833, one of those dates at which the largest number of falling stars have generally been observed in America as well as England.

The meteors on this occasion first attracted notice by their number and brilliancy about nine P.M. on the 12th of November. At eleven o'clock they were very remarkable, but became most brilliant about four A.M. of the 13th, and continued with little diminution till broad daylight, after which a few large fire-balls were seen, their light being more intense than that of day. The area over which similar phenomena were seen extended from longitude 61° to 100° west, and from the North American lakes to Jamaica. "Everywhere within

these limits the first appearance was that of fireworks of the most imposing grandeur, covering the entire vault of heaven with myriads of fire-balls resembling sky-rockets." There were, however, three varieties, the first consisting of lines of light, the second of defined fire-balls, and the third of ill-defined luminous bodies. The two latter remained for some time visible. All appeared to emanate from a point in the constellation Leo, and this point retained the same relative position among the stars during the whole night. The greater number of the meteors described an arc of 30° or 40° with some rapidity, but the undefined bodies lasted in one case for more than an hour. One of the fire-balls was heard to explode with the sound of a cannon, and slight explosions, with occasional hissing noises, were heard from time to time during the night.

Among the phenomena attendant on these lines, points, and globes of light, which sometimes evidently change their state, and burst in the air, are falls of stones and other substances. Thus on the 4th of May, 1858, an ignited globe was seen in the air, which fell down into a farm-yard, exploding with a loud report. A smell of sulphur was perceived, and incandescent fragments flew in different directions, one of which hit a cow. The straw was disturbed and turned up where the globe was seen to fall, but it was not burnt, and no hole was seen in the ground. This occurred in Buckinghamshire, about six miles north-west of Aylesbury, at the village of Quainton.

In the year 1860, there were several occasions when remarkable and brilliant appearances were seen in the heavens, followed by showers of stones falling on the earth. On the first of May in that year, about a quarter to one in the morning, a brilliant meteor, almost as large as the moon, was seen. It had a tail equal in length to twelve diameters. The whole moved on from S.E. to N.W., apparently falling, and was seen for three seconds. During and after the time when it was visible, a number of distinct explosions were heard, of which twenty-three were counted; other sounds followed like salvos of musketry, the whole duration of the sounds being two minutes.

This meteor was seen at places distant about twenty-five miles from its direct path, and the detonations were heard over an area nearly eighty miles in radius. It was estimated to be about three-eighths of a mile in diameter, and to move at the rate of four miles in a second.

When at a height above the earth of about forty miles it exploded, and black stones fell through the clouds with a whizzing sound directly after the explosions. Thirty of the stones were found on an area about ten miles in length by three in width. Of these stones one weighed 103 lbs., others half that

amount or less, the largest being furthest in the direction in which the meteor was passing. All these stones were angular. These phenomena occurred in the Northern States of North America.

On the 20th July, in the same year, two meteors were observed, both exceedingly brilliant; one apparently moving from east to west, another from west to east. The latter was seen over a length of 1000 miles of North America, shortly before ten o'clock at night. It is thus described:—"At first a single ball, it afterwards divided into two in about three minutes, the breaking up being accompanied by a report, and followed by a train of sparks and fire. Its colour was blueish; it was very brilliant, moved extremely slowly, and seemed almost to traverse the entire heavens; it seemed very near when almost overhead. Its absolute velocity in space was calculated to have been twenty-six miles a second." At its nearest approach to the earth it was calculated to be about forty miles distant. The distance of the first ball from the second, after dividing, was estimated at two miles.

In other parts of the world similar wonders have been described. Thus, on the 28th July, in the same year, in the north-eastern part of Lahore, in India, a series of shocks and explosions took place in the air, followed by flames (?) of fire and a great shower of meteoric stones, which ploughed up the earth.

Near home such events also occur. Thus, on the 5th of November, 1851, at half-past five in the afternoon of a clear day, a brilliant fire-ball was seen high up in the air near Tarragona, in Spain, and in the neighbourhood, over a distance of sixty miles. It had a luminous tail, which changed to a misty cloud, and lasted twenty minutes. Forty seconds after the fire-ball had disappeared a tremendous noise was heard, and many stones fell. One was picked up weighing 19½ lbs., and others smaller. They were picked up hot, and were coated with a black crust.

Such balls of fire bursting with loud reports, and connected with falls of stones reaching the earth, and subsequently found where they were supposed to have fallen, are comparatively rare, involving, as they do, the complete history of an event which always happens unexpectedly, and which generally astonishes and alarms too much to admit of careful investigation. But although not common, they recur constantly; few years pass by without a record of something of the kind, and each particular case presents its own peculiar phenomena, while assisting in some measure to clear away some of the difficulties experienced in the endeavour to account for them.

As a further illustration of similar phenomena seen in Eng-

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land and very carefully recorded, we may take the following:—"On the 17th December, 1852, at about five o'clock in the morning, during a severe gale, a very remarkable cloud, that had been noticed for five minutes advancing in the wind's eye, and rapidly increasing in size, was noticed to give off a number of flashes, accompanied by a singular hissing noise, like that of a shot, clearly distinguishable from the howling of the wind. In the centre of the cloud a dull red obscure nucleus, or fire-ball, was seen, about half the size of the moon, having a tail five or six times that length, from which flashes were sent forth with great brilliancy, the sounds becoming more detonating as the meteor descended through the air. At three minutes past five the nucleus suddenly exploded, with a report similar to a very heavy clap of thunder, giving out an intensely brilliant light, which rendered the minutest objects distinctly visible, although it rained at the time violently and the sky was obscured. The body of the meteor seemed to fall into the water about half a mile from the land, and was indicated by a great volume of spray which rose foaming in the distance.*

The meteoric stones that exist in a state capable of clear identification, without being directly connected with any recorded meteors, are very numerous, and are found in all parts of the world. As might be expected, however, they are rarely noticed in countries where the land is cultivated and stones kept out of the way. The countryman ploughing his land would certainly not remark anything of the kind, and the scientific man would not go into a ploughed field to make mineralogical discoveries.

Very large and fine collections of meteorites exist, however, in some of the public museums of Europe. The British Museum is especially rich, and may be examined with great advantage by the student. Space will not allow of any account of these specimens, but perhaps a few notes made last year by myself on the Vienna collection, which is certainly the next largest, and is especially rich in earthy varieties, will interest the reader. It should be explained beforehand that there are two kinds of meteoric stones—those that are almost entirely metallic, and those which consist very largely of sandstone and other earthy minerals. The former are, perhaps, the most common, but the latter are in some respects the most instructive.

The Vienna collection of meteorites is remarkable for the variety of the localities that have yielded specimens to enrich it. The collection includes portions of stones that have fallen in one hundred and seventy-five different places, and among them are many of extreme interest.

* *Proceedings of the Royal Society of London*, for January 27, 1853, vol. vi., p. 276.

The interest divides itself into three subjects, viz., the nature of the material, its form, and the appearance and condition of the surface and of the interior of the mass.

A large proportion of the specimens are of a curious mixture of iron, nickel, and other metals, frequently regarded as peculiar to meteorites in whatever the part of the world they have fallen, or whatever interval has elapsed since their fall. The other specimens are chiefly fragments, some containing scarcely a trace of iron, and others a little iron, but most of them consisting of either felspathic or silicious sand, cemented together rather loosely. The appearance is extremely similar to that attained by sand after very long exposure in a furnace. The sand is compacted into a sandstone, but the grains are very imperfectly cemented. The outside of these specimens is almost without exception black, and has every appearance of having been fused. The size of the block is various; some are pebbles, not much larger than a walnut, others are as large as a man's head; some are broken fragments. One of them is very curious, as it exhibits distinctly the cause of the smooth surface. That side of the pebble which met the air (the part that is in the direction of progress) in the rapid transit of the stone through the air, is perfectly glazed, and the glaze has run over the edge; the rest, however, is only slightly glazed.

The surface of the metallic meteorites is especially remarkable, and there are many cases in which the crystalline form can not only be recognized as an outline, but may even be measured. The usual shape of the crystals is the octahedral. In some the outside is a mass of crystals of moderate size, greatly rounded, but still recognizable. These are the larger specimens. In others of smaller size the form is more distinct and less altered by weathering. Some, however, are completely rounded externally, and give no appearance of crystallization until broken. One specimen of large size has been partly sawn and then broken. The fracture in this case marks, in the most striking manner, the crystalline state of the mass, as it gives a repetition of parallel faces along the whole length of the broken part, amounting to five inches.

The external form of the non-metallic meteorites offers nothing very remarkable, beyond the fact of the peculiar rounded surface, apparently caused by great friction—a friction which can only be due to the passage of the mass through the air at an extremely rapid pace. The internal fracture differs nothing from that of a lump of similar material on the earth. The melting that has taken place at the surface, resulting in a deep brown or black glaze, is of no great thickness, and is strictly superficial.

The internal structure of the metallic masses is curious in

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many ways, and the peculiar markings, caused apparently by the crystalline condition of the metal, are often very beautifully shown by irregular oxidation. Some specimens are covered with lines, parallel, and crossing each other with extreme regularity, resulting in a beautiful pattern. Others are less regular, but equally beautiful. Many have smooth blebs in the interior, hollow spaces once filled with pyrites which have fallen or decomposed out, leaving a perfectly smooth cavity. In some, real stones or foreign substances, more or less different from the mass of the meteorite, are buried within the mass; some are enclosed, and show from their angular surface how completely foreign they must have been; others are only partially buried, portions of them being outside. It is difficult to conceive how these may have been packed into their places.

One of the most singular of the specimens is part of a stone that fell at Tula, in Russia, in 1846. The crystalline structure was first observed in polishing a part of this specimen, which weighs 71 lbs. The original mass weighed 542 lbs.

The stones have sometimes fallen in showers. This was the case in France with some of those that have no metal, but consist almost entirely of felspathic stone. In the national museum at Prague are several large meteorites, one of which is a stone seen to fall. It is entirely melted on one side, and unchanged on the other. The melted side is quite round and smooth, and is black to the thickness of about one-sixteenth of an inch.

The various facts above stated are but a few out of a rich variety in reference to this curious subject, but they are sufficient to suggest some considerations as to their meaning, and also as to their bearing on the condition of those vast spaces that occur between the recognized and known bodies that make up our planetary system. It is an idea, not a little startling, when first presented, that besides the planets long known, and those distant ones recently discovered, and scarcely visible to the naked eye; besides those numerous asteroids or minute planets, almost all discovered during the present century, but whose number is constantly increasing, and will soon perhaps mount to a hundred; besides the satellites, which are much more numerous than was once thought; besides those wandering comets, sometimes whirling with incredible rapidity close to the sun, and then passing off for centuries or even thousands of years, lazily traversing space as they cross the orbits of the various planets, and sometimes reaching the outskirts of our system, far beyond the most distant known planet;—that besides all these, there are also belts consisting of numberless smaller fragments of matter, some metallic, others earthy, and only made evident to our senses when by some chance they enter

within the limits of our atmosphere, or when we approach so near them that they suddenly become incandescent, and glow with intense brilliancy for a few brief seconds.

There is hardly any rational way of escaping from this conclusion, that all space must be as thickly peopled with these fragments as is the air in a room with particles of dust. When the rays of the sun shine in through a narrow chink, all these minute particles in the course of a ray are made evident, and so these atoms of the dust of space are from time to time seen, not indeed when the sun is shining, but when in the dark but clear nights we watch the heavens, and note all the shining points that shoot out from the blue vault, and seem to disappear as they came. Probably, in the majority of cases, where there is merely this momentary line of brilliant light, the atom has been made bright by the friction produced, and heat evolved in passing through the thin air overhead. Heated intensely, the whole has become dissipated, being either broken up or oxidized into particles quite invisible. In other cases, where the magnitude is greater, the time longer, and the phenomena more marked, a sensible mass of matter is caught up, and though attracted by the earth and approaching its surface, yet fails to reach it, being also broken up into minute fragments of dust by the enormous friction met with before it can reach the actual land and sea. That in their course downwards these masses are occasionally swayed about, taking a zigzag or irregular path, seems certain, and now and then the actual broken fragments are seen to approach the earth, though they cannot be picked up on the spot where they appeared to fall. Now and then, however, a giant appears—a Triton among these minnows of the sky; molten on the surface by the friction, it yet succeeds in retaining its natural state, until at last it falls to the earth a solid, though rarely in an unbroken state. Masses of magnetic iron and nickel, with occasionally other metals, masses of sandstone, mixed masses of metal and sandstone, have all been picked up on the earth after falling from the sky, and have been examined by competent chemists. They are the materials that people space; they are fragments of matter widely, and perhaps universally, distributed; they are materials collected or left behind by the wild comets in their course; they may be the food of the sun, the fuel conveyed in some mysterious manner to keep up that vast burning mass that is the source of light and heat, whose rays give life, and of whose atmosphere we are now beginning to learn something from the experiments recently made on light. And these materials accord pretty well with those common on the earth. They afford no new metal or mineral. They are combinations not unknown, if not common, of very familiar ingredients.

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That our whole solar system is occupied more or less thickly by particles of matter of the same kind; that these are collected into masses, varying in size from the dust that no microscope can render visible, to the huge planet Jupiter, and the sun itself, compared with which all the known solid bodies of our system are as nothing; that all these parts to our system are mutually dependent, working together and performing some useful purpose; that there are abundant means by which waste can be supplied and a perfect balance constantly preserved;—all this is so perfectly consistent with what we know generally of the course of nature, and the good providence that has ordered all things, that the idea commends itself to our experience and would be accepted at once by most of us. But if it is so, if really this is the explanation of the phenomena of meteors, fireballs, falling stars and aërolites; if these are but the dust of our system, they yet seem to follow some definite law, not unlike that which governs our own movements round the sun. Crossing as we do the direction of this strange pell-mell of waste material chiefly at certain periods of the year, it would seem that it is a belt having definite boundaries; but as, on the other hand, though it is on special days that the phenomena are chiefly recognized, there are few nights of the year in which there are not some, there must either be many other such belts constantly crossed, or, which is more probable, all space is thus partially occupied, although there are certain limited and definite groups revolving in an orbit round the central mass of the sun.

But finally, if our own solar system is thus made up, why should not others be so? Why should not whole systems consist of matter less collected into large globes, and more spread in fragments; and why should not some or all of them be self luminous? Such a state of matter might well produce the anomalous appearances presented by unresolved nebulæ, and they would even accord pretty well with the most recent observations on many groups of what has already been called star-dust. It may be wild and fanciful to dream of possible explanations; but where, as in these celestial phenomena, the actual facts are so few, who can help speculating from even the least proved analogies, if they seem to afford a rational clue?

There is no department of science more fascinating than the discussion of these physical problems. But they must not induce us to believe that astronomy can be studied by thus revelling in fanciful dreams of celestial possibilities. They are not without interest, but this is not to be estimated at more than its real value.

THE USE OF LOW POWERS WITH DEEP EYE-PIECES.

BY HENRY J. SLACK, F.G.S.,

Member of the Microscopical Society of London.

If I may judge from the practice of those microscopists with whom I am personally acquainted, and from the best works on the subject of microscopic manipulation, it would appear that sufficient attention has not been paid to the circumstances under which magnification is best obtained by the employment of low objectives and deep eye-pieces; nor has the power of eye-pieces been as yet brought up to the highest point of practical usefulness by microscope-makers.

In the *Micrographic Dictionary* all that I notice upon eye-pieces occurs in the introduction, at the bottom of p. xvii. (second edition), and runs as follows:—"Always one, and sometimes two eye-pieces are obtained with the microscope; but the highest eye-piece which is made should always be procured, for although high eye-pieces are so far objectionable that they magnify the imperfections formed by the object-glass as well as the image itself, yet they frequently render parts of structure distinct which are perhaps only just perceptible with a lower eye-piece." This passage shows that the able authors of the *Micrographic Dictionary* merely regarded an increase in the power of the eye-piece as a substitute, of a make-shift kind, for an augmentation in the power of the objective. In the valuable lectures of Mr. Lionel Beale, entitled, *How to Work with the Microscope*, the eye-piece question is only glanced at, and in the last edition of Dr. Carpenter's *Microscope and its Revelations*, which is universally regarded as the best authority on the practical use of the instrument, we are told that the utility of deep eye-pieces will mainly depend upon the excellence of the objectives, and that the best objectives, by permitting the use of deep eye-pieces, with little loss of light or definition, afford us a clear gain in range of power, if compared with inferior productions that will only work with low eye-pieces, through not being able to stand the magnification of their defects.

These remarks are true and valuable; but, like those in the *Micrographic Dictionary*, they omit the consideration of the advantages which low objectives and deep eye-pieces have, for certain inquiries, over higher objectives and eye-pieces of less power, and it is to this point that I wish to draw the attention of your numerous microscopic readers.

Every one knows that the penetration of low object-glasses

is greater than that of high ones, using the word in the sense judiciously assigned to it by Dr. Carpenter, who tells us that "the penetrating power of an object-glass (good definition being, of course, presupposed) mainly depends upon the degree of distinctness with which parts of the object that are a little out of focus can be discerned; this," he adds, "will be found to vary greatly in different objectives, being within certain limits in an inverse proportion to the extent of the angle of aperture. . . . . Hence, an objective of comparatively limited aperture may enable the observer to gain a view of the *whole* of an object, the several parts of whose structure lie at different distances from it, sufficiently good to afford an adequate idea of the relation of those parts to each other; whilst if the same object be looked at with an objective of very wide angle of aperture, which only enables what is precisely in focus to be seen at all, each part can only be separately discerned, and the mutual relations of the whole cannot be brought into view."

This passage plainly indicates the advantage of using glasses with moderate angles of aperture when much penetrating power is required; but the principle upon which the advice is given may be extended to a very wide range, if very low objectives, which necessarily have small angles of aperture, are made to give the needful magnification in combination with deep eye-pieces adapted to that end.

Microscopic pursuits always require sound definition, and that being presupposed, we shall find that, according to their nature, they demand penetrating power and resolving power in very different degrees. Were it possible to combine both in the highest degree, the most perfect glass would be obtained; but in point of fact the two stand in such relation that if either is wanted in excess, the other must give way. The student of diatoms, very curious in the minute and closely-approximated markings which ornament the surface of certain valves, is content to surrender penetration in exchange for the enormous resolving power afforded by certain large-angled objectives of Powell and Lealand, or Ross. But there is a class of inquiries that stands at the very antipodes of these researches, and in which very little resolving power is needed, provided considerable magnification can be obtained, accompanied by so much penetration that uneven objects can have all their parts exhibited at one view. When this is required—whether it has been with or without reflexion upon the optical principles involved—most microscopists have no doubt preferred using an inch object-glass with a second or third eye-piece, to a half-inch with a lower one; but the most striking advantage of this description may be obtained with a *three-inch objective* worked up to

any power that may be needed, between 15 to 200 linear, or even more.

The practical direction should be—when you must have considerable *resolving* power, use a proportionately deep object-glass; when you must have great *penetrating* power, use a low one, and gain your enlargement by the eye-piece, if the object be small. Much more penetrating power is lost in doubling or trebling a given magnification by having recourse to an objective of larger angle of aperture and shorter focal length, than by resorting to an eye-piece of the required strength. The mouth apparatus of moderate sized insects, the cells and appendages of zoophytes and similar objects, in which various parts are in different planes, may be well shown with a three-inch object-glass, and the first, second, or third eye-piece of Smith and Beck's series, when half the parts would be out of focus if a two-thirds object-glass were employed to give the same power. I have, for example, a slide containing that exquisite little snailshell, the *Helix pulchella*, which shows beautifully as an opaque object with about forty-five linear enlargement. Gain this with an inch objective, and part is out of focus; gain it with a three-inch, and all is taken in. Here again are some Foraminifera, *Orbiculina*, *Globigerina*, etc., and their ins and outs can be displayed better with the three-inch worked up with draw-tube or eye-piece than by any other means.

The eye-pieces supplied by different makers vary in power. Smith and Beck put three down in their catalogue: the first nearly agreeing with that of other celebrated makers; the second adding three-quarters to the power of the first, making 60, for example, into 105; and the third trebling the power of the first. Much higher eye-pieces upon the Huyghenian plan are of restricted use, on account of loss of light and limitation of field; but Ross,* Powell and Lealand (and Smith and Beck, if required) supply eye-pieces which give about five times the power of the A, or No. 1. By such means a three-inch objective, giving 15,† with my first eye-piece, may be raised to 75 with comparatively little loss of penetration, and good performance upon any object that will bear the loss of light and limitation of field. It would however be desirable to substitute for the fifth Huyghenian eye-piece an achromatic one like Horne and Thornthwaite's aplanatic, or a better combination if it could be devised; but if the principle of

* Mr. Ross has lately made an F eye-piece, giving about eight times the power of the A.

† The three-inch employed was by Baker, and estimated to give a power of 17, with his first eye-piece, which is, I believe, somewhat higher than the corresponding power of other makers.

pushing the power of a low objective be carried much beyond five times the result of the first eye-piece, a totally different construction must be resorted to, or the field will be inconveniently restricted and the light too weak. What may be the best possible form I leave to those specially skilled in optics, and to our great microscope makers; but there is an admirable telescope eye-piece made by Steinheil, of Munich, which works well with a three-inch at ten times the power of the first microscope eye-piece, or at much more if the draw-tube be employed. With this eye-piece and my three-inch I obtain highly advantageous views of small irregular zoophyte cells, and of some of the larger diatoms, whose parts, like those of the *Campylodiscus spiralis*, lie in such different planes as not to come into focus at once if half-inch or higher objectives are employed. Some of the uneven circular diatoms exhibit their concavities and convexities in a surprising manner by this treatment and dark ground illumination. Of course there is a sacrifice of the minute details that cannot be seen without a higher angle of aperture, which must be resorted to for that purpose; but the gain, and a very important one for special inquiries, is in the *penetration*, which is sufficient to bring all parts into simultaneous view.

The eye-piece used in these experiments was sent to me by Steinheil as being the best—indeed the only one, he said, would be satisfactory as regarded light and field—to obtain a power of 300 with an excellent 42-inch telescope, having a three-inch object glass (made by him) upon Gauss's plan. Used as a microscope eye-piece it is nearly as light as a much lower Huyghenian one, and with the three-inch objective takes in a field one-twentieth of an inch in diameter, with a magnification of 150. A power of 130 obtained with a two-thirds, second eye-piece, and two and-a-half inches of draw-tube, had the same field. It is called in Steinheil's catalogue *Mikroskop als Ocular*, and is an erecting combination composed of three plano-convex lenses and a compound front lens. I have used it in extreme ways—with the three-inch power, and with Smith and Beck's one-twentieth, when the enlargement is enormous, and might be advantageous for special inquiries. It is however with very low objectives that I think very high eye-pieces may be most usefully employed, and if the attention of microscopists is directed to the question many objects will become visible *as wholes*, which have hitherto only been looked at in a piecemeal way.

Small crystals, like those of arsenic, which have polyhedral figures, cannot be well shown if such a power as 150 to 200 be obtained in the usual way. If you focus the tops of the pyramids, the bottoms are out of sight, and *vice versa;* but all

comes in at once with the three-inch and the *Mikroskop als Ocular*.

Many persons have Huyghenian telescope eye-pieces higher than those supplied with microscopes, and they will do very well for experiments. If not too high they will succeed; and if they are too high, they will serve to show when another optical combination must be resorted to in order to afford enough light and a sufficient field.

Although the preceding remarks relate chiefly to the employment of so low an objective as a three-inch, the principle upon which they are founded indicates when a two-thirds may be made to do better than one-fourth, or one-fourth than one-eighth.

THE PHASCUMS, OR EARTH MOSSES.

BY M. G. CAMPBELL.

HAVE any of our readers observed on moist shady banks or fallows, or recently-turned earth, a kind of greenish hue, hardly more to the naked eye than a verdant mildew? When next seen, let them possess themselves of a small bit, by sliding the point of a penknife under a little tuft of it. The plant is far too delicate for the touch of human fingers.

We will suppose this done, and that the tuft is placed under the microscope at the true focal distance from the object-glass. What a forest is revealed by that magic instrument! True, the trees are, many of them, all but stemless, and their modest fruit hides amid the foliage; but how exquisite is that foliage, especially if taken fresh from a damp spot, or if suffered to imbibe a drop of water, which, filling the cells, will expand the leaf to its full proportions.

These plants are of rapid growth and brief duration. Several of them may be found in autumn, and also in spring; some in winter. Wilson has enumerated and described eighteen distinct species of earth-moss, exclusive of the Archidium, or clay-moss, which is an allied species. They are chiefly annuals, with a capsule, very shortly pedicellate, and a calyptra falling away entire, while the capsule is without a deciduous lid, and when mature bursts irregularly to give exit to the small spores, the provision for a future generation of Phascums. These spores the earth receives and garners till congenial circumstances wake up the germ of vitality that slumbers within them, when they shoot forth their little thread-like thalli by hundreds, attain the dignity of perfect plants and of parents, and then

die, leaving the earth a heritage for their progeny, and somewhat the richer for their having lived upon it.

Growing on rather a sandy soil we have the *Phascum serratum*. Its generic name is taken from φύσκιον, a bladder, in allusion to the bladder-like capsule of the genus, and its distinctive appellation *serratum*, from the serrated leaves, their edges being toothed like a saw. But what are these branching threads rising up between the leaves, looking like another kind of moss intertwined with it? Not so; they are the young conferva-like shoots of the plant itself, not yet developed into maturity. In the first stage of vegetation all mosses have analogous shoots, but they are more conspicuous in this and its allies than in most other genera, and in *P. serratum* might at first sight easily be mistaken for an intruder. It was, doubtless, these confervoid shoots which caused Dickson and Smith to give this species the name of *Phascum stoloniferum*—a stolon being a long horizontal shoot from the base of a stem: though Wilson seems to think that *P. stoloniferum* of Dickson is a peculiar state of this species, "without the confervoid shoots growing in a scattered manner, with larger, narrower, and more evidently toothed leaves, and with creeping stolons."

The serrated leaves are nerveless, lanceolate, and connivent, *i. e.*, all tending to a central point, embracing the capsule, which is roundish-ovate, and sub-sessile, large in proportion to the plant, of a bright, reddish brown, and somewhat pointed.

Authors differ on the subject of the inflorescence, but in all the specimens we have examined we have found it monoicous, the barren or male flower gemmiform or bud-like, and situated at, or near, the base of the fertile flower; the antheridia are few, and without those succulent-jointed, hair-like bodies often found growing mixed with the antheridia and archegonia, and called *paraphyses:* but, as if to make up for the shortness of the term of their existence, the spores are numerous. We cannot say that we have counted them, but Wilson says they are about 200, yellowish, rough, and globular, as in most of the species.

As we have already said, the Phascums are without a deciduous lid, the seed-vessel therefore remains closed at the top; but when the spores are ripe they burst through the fostering walls that have thus far nourished and protected them, and launch out into the wide world, leaving a fracture on the side of the capsule, which presents the appearance of a chasm, not unlike a miniature crater on the side of an extinct volcano.

In the magnified figure given of the ruptured capsule, one leaf seems blown aside by the spores in their forcible passage out, and this was precisely the appearance under a high magnifying power.

The Phascums are among the most minute of mosses. Our illustration of *P. serratum* shows it in an advanced stage of maturity, and very greatly magnified, the confervoid shoot developed into a long, irregularly-toothed leaf. The network of the leaf appearing only like alternate lines, light and dark, a little higher magnifying power, or a little more light thrown on a single, separated leaf, would show the beautiful reticulation. The species is not unfrequent upon sandy shaded banks, though Hooker says of the whole tribe of Phascums, that they are more frequently met with in the southern, than in the northern parts of Great Britain.

PHASCUM SERRATUM,
Shewing the Capsule burst for the emission of Spores. Very highly magnified.

Another and still more common species is *P. muticum*, or common dwarf earth-moss, found on moist banks and fallows, and fruiting at the same season as *P. serratum*, viz., in autumn and spring. The leaves in this species are widely ovate-acuminate, nerved, very concave, so as sometimes to appear almost hemispherical, the two innermost larger than the rest, erect, minutely toothed above, and all connivent, embracing the immersed fruit, a tuft of this moss looking like a cluster of minute bulbs.

When mature, this species is without the converva-like shoots so conspicuous in *P. serratum*. The capsule is round,

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of a reddish colour, thick texture, and is seated on a short, thick pedicel; the columella distinct; calyptra very small, erect, campanulate, covering only the apex of the capsule; spores small, smooth, and round. Barren flower gemmiform at the base of the fertile; antheridia without paraphyses.

Phascum Floerkeanum, or Floerke's dwarf earth-moss, also fruits in September and November. It grows upon clayey or chalky soil, but is less readily discovered than its allies, not merely from its minuteness, being only about one-twentieth of an inch in height, but also from the absence of greenness, its colour being brownish, and scarcely different from that of the soil on which it grows. It is found in scattered patches, has scarcely any stem, and few, but crowded leaves, the lower ones very small and nerveless, the upper ones larger, with an excurrent nerve, concave, slightly recurved at the point, and with a reflexed margin. The areolæ small and rhomboid.

The capsule, which is entirely covered by the leaves, is of a reddish-brown, roundish-ovate in shape, with a thick blunt beak or point, one-third of its own length, and seated on a very short, thick pedicel. The calyptra is sub-conical, sometimes, but not often, cloven on one side. The barren flower is axillary, and the antheridia naked; the spores small, pale, and numerous.

Most beautiful is the foliage of *P. cohærens*, fruiting in the winter, and also bearing an immersed sub-sessile capsule. The leaves are erect, carinate, ovate-lanceolate, usually nerved to the apex; but sometimes the nerve is wanting, or incomplete: the areolæ of the leaf, however, as seen through the microscope, present the appearance of a symmetrical network, and all the upper part of the leaf is serrated.

Among the larger members of the family are *P. alternifolium* and *P. multicapsulare*, both somewhat rare, or overlooked, and both fruiting in the spring.

Other members of the family have exserted capsules, as *P. rectum*, *P. bryoides*, *P. nitidum*, and *P. curvicollum*. Of these, *P. rectum*, or the Straight-necked earth-moss, bears its fruit in winter, and on a straight elongated pedicel. *P. curvicollum*, or the Swan-necked earth-moss, has an exserted cernuous* capsule on a *curved* elongated pedicel. *P. nitidum*, or Delicate earth-moss, grows on moist banks, or on the dried sediment of shallow pools; the height of its stem one to six lines, erect, simple or branched, with new growths, like supplementary extensions of the stem, immediately below the fertile flower, each of these extensions bearing another fertile flower, and in time another, so that sometimes several capsules in different stages may be found at intervals along the stem, giving it the appearance of being pleurocarpous, or lateral

* Bending forward; from *cerneo*, to stoop with the face forward.

fruited, though the fruit is really terminal. The capsule is of a pale brown, of fragile texture, elliptical, with a short, oblique point. Inflorescence monoicous; fruit, autumn and spring.

DISEASE GENERATED BY INFUSORIA.

M. DAVAINE communicated, a short while since, to the French Academy, a paper on the discovery of infusoria, belonging to the genus *Bacterium*, in the blood of animals afflicted with a disease of the spleen (*sang de rate*). Following this, came another paper by M. Signol, to the effect that these infusoria had been noticed by Fuchs in 1848, and also by M. Brauell of Dorpat, and by M. Pollender. He likewise stated that they had been described by M. Delafond, in the *Bulletin des Séances de la Société des Veterinaires*, in 1860. M. Signol affirms that they appear in horses suffering from typhoid disorders, influenza, etc.; and he adduces a case of their appearance in the blood of a horse that died of gangrene which supervened upon a wound from a pair of scissors. He sums up his conclusions as follows:—

(1) "That bacteriums are not peculiar to the blood of animals suffering from spleen disease (*sang de rate*). (2) That blood containing them will inoculate and give rise to abundance of the same creatures in the blood of other animals so treated. (3) That the presence of fat in the tissues and fluids of the economy, the obese state of the afflicted creatures, the resemblance noted by M. Davaine between these bacteriums and those occurring in butyric fermentation, establishes a presumption that fat plays an important part in these phenomenon."

M. Davaine resumed the subject in a second communication,* which contains the following remarks:—

"In fourteen inoculations of rabbits made with fresh blood infected with bacteriums, similar organisms were reproduced and death supervened. In many cases the infusoria were observed two, four, and five hours before the death of the inoculated animal. In several of these cases blood taken from the animals while still alive transmitted the malady and determined its death with bacterium infection.

"The bacteriums are developed in the blood, and not in any special organ. When by persevering search any of these bodies are discovered at the beginning of the infection, they

* See "Pasteur on Putrefaction," INTELLECTUAL OBSERVER, Sept. 1863. *Comptes Rendus*, 10th August, 1863.

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are very short as well as very scarce, but they will soon be seen to multiply and grow rapidly, their complete evolution only requiring a few hours for its accomplishment. A rabbit, the blood of which merely exhibited a few bacteriums, from four to six thousandths of a millimeter in length, died at the end of four hours, and its blood, which was examined immediately afterwards, contained a considerable number of bacteriums, some of which, larger than any I had previously seen, reached the five-hundredth of a millimeter in length.

"In some animals the bacteriums are generally found larger than in others, but not presenting any other difference. In such cases their number was usually less. The length which the filaments sometimes acquired suggests their classification among the Confervæ; but I omit, for the moment, the discussion of this question, as it has little importance in the present inquiry.

"The number of the bacteriums varies much between one animal and another. After my first inoculations this number decreased very rapidly, and they became eight or ten times less than the blood corpuscles. This led me to believe that their propagating power dwindled in rabbits, but I was afterwards convinced that such was not the case, as in a series of eleven individuals, one inoculating the other in succession, the blood of the tenth contained myriads of bacteriums like that of the first. I can only explain these variations by the changes in atmospheric temperature which occurred during my experiments.

"When the infected animal dies the bacteriums cease to multiply or grow, and in blood removed from its vessels they become destroyed or transformed. The loss of their primitive aspect is accompanied by loss of the power of propagating themselves in a living animal. Two inoculations effected, one with sheep's blood kept for eight days, the other with rabbit's blood kept six days, neither occasioned the spleen disease nor the formation of bacteriums.

"When fresh blood is rapidly dried in free air, the bacteriums preserve the faculty of inoculation, as I found in many experiments. The dried blood can sustain a temperature of 95° to 100° (C.) without this faculty being destroyed.

"Some fresh blood was enclosed in a tube and kept for ten minutes in water in ebullition. This blood being afterwards introduced under the skin of a rabbit, led to its decease, with formation of bacteriums in thirty-one hours. Cooking is therefore insufficient to destroy their vitality.

"In fourteen rabbits the mean duration of life after inoculation was forty hours; the shortest period being twenty-eight hours, and the longest sixty-seven. The duration was longer

in adults and old animals than in young ones. During this period the bacteriums are slow to appear, but from the moment of their occurrence the animal has but a short time to live. The longest interval that I have observed between the appearance of the bacteriums and the death of the inoculated animals was five hours, thus the mean length of the incubation period is thirty-five hours.

"During the incubation period the animal loses nothing in power or agility; it is only in the last two hours, when the bacteriums exist in notable quantity, that the rabbit ceases to eat or to run. It then lies on its belly, grows rapidly weak, and dies without any special symptom. Sometimes, however, death is preceded by slight convulsive movements."

M. Davaine goes on to say that autopsy shows a healthy condition of the large organs, but the heart and large vessels are distended by very cohesive clots. Coagulation of the blood is thus the only apparent cause of death. During life the microscope shows this coagulative action, as the increase of the bacterium is found to be associated with a viscosity of the red globules, and a tendency for them to adhere together. The large organs only contain the bacteriums as a consequence of their vascularity, and the spleen, which is very vascular, appears the focus of their reproduction.

M. Davaine concludes this paper by observing that experience shows the appearance of bacteriums in the blood precedes the phenomena of disease, and it is therefore natural to refer the latter to the former, which enjoy an individual vitality, and propagate themselves after the manner of living beings. While the blood only contains them in the germ; while their development is not effectuated, the morbid phenomena are not produced. But if the question is examined from another point of view, it seems probable that blood in which they have not made their appearance would be incapable of propagating them in a new animal, that is to say, that during the period of incubation they could not be sown, and the spleen disease (*sang de rate*) could not be communicated by inoculation.

In a third paper M. Davaine states that he inoculated a healthy and vigorous rabbit with three or four drops of blood from another rabbit infested with bacteriums, but still living. Forty-six hours after the inoculation, being six hours beyond the mean time of death, he examined the inoculated rabbit without finding any bacteriums. He then took from its ear twelve to fifteen drops of blood, that were injected into the sub-cutaneous tissue of a third rabbit, about two-and-a-half months old. Nine hours after this the rabbit first inoculated was found to contain a quantity of bacteriums, and some blood from its ear was introduced into the sub-cutaneous tissue of a fourth

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rabbit. One hour after this last inoculation the rabbit first operated on died, and twenty hours afterwards the rabbit last inoculated died; but the rabbit that was inoculated with the blood in which the bacteriums had not made their appearance remained quite well. M. Davaine considers that no one can doubt the connection between the bacteriums and the disease, and he says "by their presence and by their rapid multiplication in the blood, they give rise, after the manner of ferments, to modifications in the blood, which speedily cause the decease of the infected animal."

M. Pasteur has shown that different kinds of fermentation and putrefaction are acts correlative with the lives of organisms of analogous character, and it seems probable that the laws of dialysis, investigated by Mr. Graham, are intimately connected with the chemical influence exerted by these creatures upon the fluids in which they grow.

M. PISSIS ON THE ANDES.

M. Pissis, who has long resided in South America, has presented several memoirs to the French Academy on the geology of that country. These papers, having been considered by a commission composed of M.M. Elie de Beaumont, Boussingault, Danbrée, and St. Claire Deville, form the subject of a report which will be found in *Comptes Rendus* for 6th July, 1863, from which the following particulars are taken:—

M. Pissis occupied part of his time in determination of mountain heights, among others those of the elevated peaks surrounding lake Titicaca. The report states, "the altitudes ascribed by him to Illimani and to Nevado de Sorata agree with those deduced from the measurements of Mr. Pentland, made during his second voyage to Bolivia, and with which M. Pissis could not have been acquainted. This fortunate agreement between two able observers leaves no doubt that Chimborazo exceeds by some hundred meters the two colossal mountains of Upper Peru.

"It was also reserved for M. Pissis to determine by a complete geodesic operation the height of Aconcagua, the most elevated of the yet known peaks of South America. Measured by means of two different bases, Aconcagua appears to have an altitude of 6834 meters, and thus to exceed Chimborazo by about 300 meters." In a note the commission refer to Mr. Pentland's estimation of 7300 meters for this mountain, which they say differs little from that of Captains Beechey and Fitzroy. They proceed to quote the words of M. Pissis, who observes

that, "in a geological point of view, this mountain, ordinarily spoken of as the volcano of Aconcagua, is in reality not volcanic. It is composed," according to M. Pissis, "from its base to its summit of stratified rocks, the lowest of which is composed of those same porphyries met with at every step on the Andes; while those on the summit, as judged of from some detached blocks, appear to belong to the cretacean system. It occupies the middle of a great circle situated a little to the east of the line of the Andes, from which it is separated by the valley in which the Rio de Mendoza has its birth. Some syenitic rocks show themselves in the lower part of this circle, which, at the time of my visit, was almost entirely filled with snow, which prevented my satisfying myself whether it contained eruptive rocks of more recent origin."

The commission remark that, "in spite of the just reserve of M. Pissis, it is difficult to avoid the conclusion that the peak of Aconcagua occupies the bottom of a vast crater of elevation," a conclusion with which few English geologists would concur. Aconcagua is far from being isolated, as M. Pissis mentions three other peaks in its neighbourhood, reaching elevations of 6799, 6527, and 6347 meters. "Everything indicates that on that spot the most elevated mountain masses of the American Continent are found."

A study of the movements by which its present relief was imparted to the South American Continent has led M. Pissis to assert that its stratifications present *nine* general divisions:—

"1. The Chilian System, *i.e.*, the most modern of all, and posterior to the marine sands Atacama (remarkable for their deposits of nitrates) and to the formations of transport (*terrains de transport*) of la Paz.

"2. The System of the Principal Chain of the Andes of Chili, posterior to the lacustrine and marine deposits of Bolivia, of Chili, and of Patagonia, having a direction exactly N. and S., with appearance of trachytes and argentiferous seams.

"3. The System of the Transverse Chains of Chili, posterior to the calcareous and saline marls, having a direction approximately E. and W.: Labrador rocks and cupriferous beds.

"4. The Western Chain of Chili System, anterior to the saliferous marls, posterior to the '*grès rouges*:' direction sensibly the same as in the first system: syenitic rocks, auriferous pyrites.

"5. The Eastern Chain of Chili System, the elevation of which, contemporaneous with the eruption of quartziferous porphyries, occurred during the Jurassic period.

"6. The System of Itacolumi, the appearance of which

was posterior to the carboniferous lime, and anterior to the *grès rouges* of South America.

"7, 8, 9. ELEVATIONS OF SCHIST ROCKS OF SOUTH AMERICA, of which M. Pissis distinguishes three kinds, all very old."

M. Pissis considers that each movement of elevation was characterized by the emission of a particular rock, which takes the place of a characteristic fossil in the determination of its age.

THE PLANET MARS: A FRAGMENT.

BY THE REV. T. W. WEBB, M.A., F.R.A.S.

(*With a Coloured Plate.*)

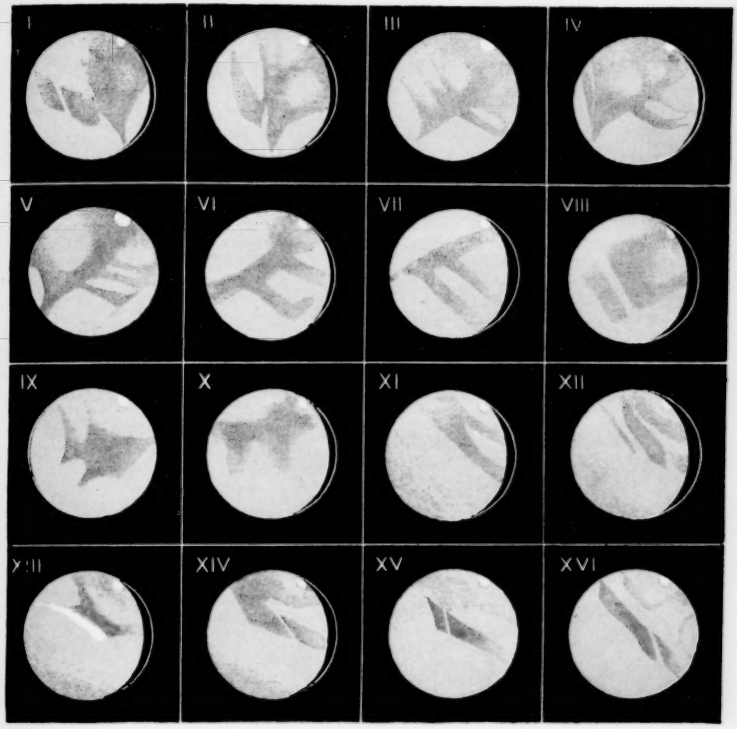
"I give the first watch of the night
To the red planet Mars."—LONGFELLOW.

FROM the tenor of some remarks which appeared in the present publication previous to the late opposition of MARS,* the idea may possibly have been entertained that the author of them intended to avail himself of that opportunity to make some detailed observations upon the aspect of this interesting planet. The impression would have been well-founded. I had purposed to undertake a careful examination of the physical features of Mars, as far as they would be brought out by the power of an excellent 5½ inch object-glass, and securing, if possible, a delineation of as much of his surface as would at that time be exposed to view. It was indeed to be expected that the same task would be taken in hand by far superior observers, armed with much more powerful instruments, and, in part, favoured by purer skies; yet it did not seem to follow that a more humble attempt would be superseded, or would necessarily prove entirely useless; for it has not unfrequently been the case that inferior observations have found a place for themselves in that general accumulation of materials from which our final deductions have to be inferred. The peculiarly valuable investigations of Beer and Mädler were long carried on with an object-glass of not more than 4½ inches aperture; and a quotation which they have employed will furnish an appropriate motto for any similar case:—

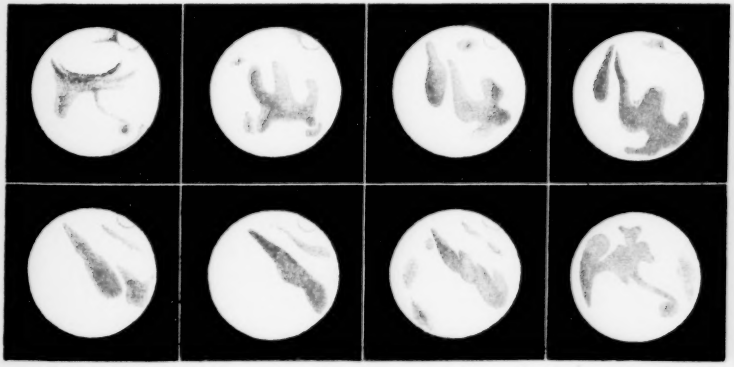
"Quod potui feci; faciant meliora potentes."

The execution of my design proved indeed far more defective than I had anticipated. Absence from home, cloudy weather, and seasons of bad definition conspired to interpose

* INTELLECTUAL OBSERVER, viii. 132. See also xi. 376.



WEBB, 1862.



BEER AND MAEDLER, 1830, 1832.

obstacles of a grave character, and at length my series of sketches, a great proportion of which were of a rough, imperfect nature, were found to combine into a delineation, of which some parts were especially unsatisfactory. Nevertheless, I have not felt disposed to suppress my results, because I have thought that they may prove interesting to other observers not more successful than myself, and because I believe that, notwithstanding all their shortcomings, they sufficiently establish the two points I had especially in view—the permanency of the principal configurations of the planet, and their occasional obscuration from some transitory cause. For this purpose, however, a reference to former observations would obviously be essential; and here considerable difficulty arose. My original intention was to have given an extended selection from all the previous designs to which I could obtain access, but I was subsequently led to prefer a comparison with the work of Beer and Mädler alone, as a well-known and accredited authority, and fully sufficient for my purpose; and hence I have not availed myself of some obliging offers of assistance from contemporary observers; partial illustration of this nature tending to produce confusion in a somewhat perplexing subject, whose complete elucidation must be given, if at all, from a more comprehensive point of view. Having made choice of Beer and Mädler as my standard of comparison, I thought it right, in order to secure impartiality, to avoid looking at their designs, and indeed almost any others, during the whole course of my observations; and as I had not previously referred to their work for a long time, I was enabled to escape any bias either of the eye or the judgment. However defective my result may appear, it has at any rate been attained by an independent procedure.

A superficial comparison of the published views of Mars would be likely to lead to the idea that, with occasional generic resemblances, such as exist in the case of the belts of Jupiter, the differences are too wide and too irreconcilable to be accounted for on the supposition that we see the permanent features of the planet. But many circumstances would require to be taken into consideration before such a conclusion would be admissible. We have to bear in mind the minuteness of our object: the globe of Mars is but about twice as large as the Moon, and its distance towards forty millions of miles; so that Beer and Mädler found it desirable to employ a power of three hundred to develope its details satisfactorily, and even with this they only unfolded themselves gradually to the eye. A lower power I found indeed adequate, but with an aperture giving me about half as much more light; and when the weather would admit of it, was glad to follow their example. Again,

we have to contend with the peculiar difficulties presented by spherical perspective; difficulties that would hardly be imagined by an inattentive observer. Our eyes are apt to be misled by being accustomed in youth to the common projection of the earth in two hemispheres, till we get to suppose that such would be a real view of our planet at a distance; but this impression is highly erroneous. In such maps, where the half of the globe is attempted to be as it were squeezed flat, the marginal regions are necessarily enlarged, and the central parts reduced, to effect some kind of conventional correspondence, and render the map of any use; and we gain no idea from it how extreme, in nature, is the foreshortening towards the edges of a globe in a perspective view; how small a portion of it is seen in its true dimensions; and how soon, in every direction, the surface rounds off and falls away from the sight. This however, great as it is, is not all the difficulty. Were the position of the axis of the globe invariable with respect to the observer, though much of the surface towards the poles would be very ill seen, the perspective of what is seen would be constant, and readily intelligible, as we notice in the case of Jupiter, whose polar regions are foreshortened to obscurity, but whose equator lies always alike straight before the eye. But where, as in Mars, the axis is at different epochs very differently presented to our sight, though more of the surface is in the end rendered visible, yet the effect of perspective is much more complicated, and the apparent changes of form resulting from it much more perplexing. All this may be readily illustrated by means of a terrestrial globe viewed from a fixed position. If, in the first instance, its axis is placed vertically, the effect of rotation will be a wide difference in the apparent form of the continents as they occupy the edges or pass across the centre, and we shall be convinced how very unlike must be the hemisphere of the map-makers to that beheld by a distant external eye: these changes however will be regularly recurrent; all the parallels of latitude will continue sensibly straight; and the central aspect will be successively always the same. But if we now incline the axis about $23\frac{1}{2}^{\circ}$, and place it in various directions towards the eye, so that at one time both poles shall be in the limb, at others each in turn shall be more or less advanced towards the spectator, the surface will be presented in aspects continually varying; the parallels of latitude will be at one time straight, at others projected as semi-ellipses, with a curvature turned sometimes one way, sometimes the other, according to the position of the axis; even the central representations will be quite unlike at different times, though the same side, in a general sense, may be opposite to us; and the effect of rotation will be a change, in

every case, of perspective foreshortening and apparent direction of motion; so that a succession of views of the Earth, as obtained in different positions from the Moon or Venus, would exhibit a strange degree of dissimilarity, and much difficulty at first in identification. All this holds true with regard to our views of Mars, and even more, from the greater inclination of his axis, amounting to about $28\frac{3}{4}°$:* and here we find the principal source of the obvious and, at first sight, almost irreconcilable differences in the existing views. To this we must also add other casual sources of deception, such as the misleading of the eye, by the oblique passage of the axis through the field of the telescope, where there is no clockwork motion; by the effect of phasis, not always duly allowed for, especially when a ready-prepared circle is used for delineation; and by the fact that the defalcation does not necessarily begin at the white polar spot, but at, or not far from, the apparent vertex. Some of these causes of error, I have had subsequent reason to think, have affected my own sketches, and possibly may have influenced those of other observers. All this considered, we shall cease to wonder at the striking dissimilarity in the representations of Mars taken at different epochs; and when we have added the equivalent of what astronomers call "personal equation"—the strangely varying judgment formed by different eyes, and occasionally by the same eye under different circumstances—as well as the inadequacy of many hands in delineation, we shall see reason why even views of the same opposition, taken by different observers, are often more unlike than might have been expected.

With respect to the drawings accompanying this paper some explanation is requisite. They are the best out of a set of forty-three, extending from September 16 to December 20, 1862; and, being intended to exhibit every portion of the globe then visible in succession, with some repetitions for the illustration of details, they stand in the order of *rotation* and not of *time*. The apparent irregularity which will be remarked in the position and magnitude of the phasis arises from this cause; its real value having been carefully attended to in each instance.† Equality of size has been adopted for convenience, but in fact the diminution of the disc towards the close, December 20 giving only 10″·4 against 21″·8 on September 26, was such as

* This quantity is subject occasionally to a slight apparent increase, arising from the inclination of the orbit of Mars to our own, which amounts, according to Lindenau's Tables, as cited by Arago, to 1° 51′ 6″·2. This value differs somewhat from that given by Sir William Herschel, who makes the inclination of the axis of Mars to our ecliptic 30° 18′, and to the plane of his orbit 28° 42′.

† The same singular and unexplained anomaly of phasis is said by Mädler to occur in Mars as in Venus (see INT. OBS. xviii. 455), *the observed always falling short of the computed magnitude.*

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to render the later observations much more difficult and precarious. The position of the axis, as indicated by the snow-spot, is represented as inclined about 30° to the meridian; but this was a mere rough estimate, no measurement having been attempted. The more luminous part of the disc had rather a yellow than a red cast in the telescope: the darker spots were grey, slightly tinged with blue, or perhaps greenish blue. Only two of the sketches here engraved (Figs. IV. and V.) were coloured at the time, the others being not considered worth the trouble; but they have been all tinted in the plate for the sake of uniformity. The reader, however, is requested to lay no great stress upon details, as, from imperfect definition, or the planet's increased distance, many of them are of the roughest character, and no attempt has been made to retouch or harmonize them. Fig. V. is probably the best, having been compiled from three separate sketches on the same night with a power of 170: there was "so much fog as probably to diminish the planet's light by $\frac{1}{3}$rd or $\frac{1}{4}$th, but very nice definition, and the disc just like a distant globe." Such remarks were rare indeed. The observing power was usually 170, quite high enough for the ordinary state of the air in an unfavourable season; but on some occasions 275, 300, and even 460, were used with advantage. I repeatedly caught momentary glimpses of very curious detail in the dusky markings, which were immediately snatched away by the fluctuation of the atmosphere; and on one occasion especially (November 10), the unsteadiness of my stand in a violent wind deprived me of many interesting particulars of this nature which seemed otherwise accessible.

The following were the approximate dates of the selected drawings, and the circumstances of the observations:—No. I. Nov. 10d. 10h.—II. 10h. 40m.; steady but rather woolly definition, with very baffling and annoying wind; in best glimpses the tone of the dark portions was very dappled and uneven; the spot C* was evidently full of detail. The left side of the fan towards the centre of the disc was darkened in a line with the bright division beneath it, the continuation of which was to-night very difficult to be perceived, though in other sketches it is carried through boldly.—III. Sept. 29d. (hour in error); inferior definition and time limited.—IV. Nov. 5d. 10h. 15m; good definition, with an unpleasant flare and uncertain focus.—V. Sept. 26d. (hour in error); great distinctness in foggy air.—VI. Nov. 4d. 11h. 5m; markings feeble, especially considering the sharpness of the limb.—VII. Dec. 10d. 9h. 30m.; disc sharp even with 460.—VIII. Dec. 8d. 10h. 30m.; very faint, and stand unsteady in high wind.—IX. Sept. 19d. 10h. 45m.; pretty good defi-

* See Diagram, *postea*.

nition.*—X. Nov. 26d. 6h. 30m.; very faint and uncertain. —XI. Nov. 24d. 9h; "Painfully woolly, though the limb is clear."—XII. Nov. 24d. 10h. 10m.; somewhat darker and more decided.—XIII. Nov. 22d. 9h. 20m.; definition very fine; limb and polar spot very sharp, but spots ill marked and feeble. The planet is growing very small and gibbous.—XIV. Nov. 15d. 7h. 10m.; transparent sky and pretty good definition, but spots faint and confused.—XV. Oct. 9d. 8h. 5m.; sharp definition, but unequal to fine details.—XVI. Oct. 8d. 10h. 20m.; the same conditions; N. edge of long spot very hard and strong across the centre; spots further S. very faint and ill defined.

It fortunately happened that the opposition of 1830, so carefully observed by Beer and Mädler, and even that of 1832, were combined with a presentation of the axis sufficiently similar to admit of a very fair collation with that of 1862, and consequently eight of their figures, the first six belonging to the former, and the others to the latter epoch, are subjoined at the lower part of the plate, being left untinted to correspond with the originals, but having their axes inclined for the sake of comparison.

The sides, if a globe can be said to have sides, delineated in my Figs. I. to IV. and XIV. to XVI., I consider the best determined; comprising, I am sorry to add, not much more than a hemisphere: the rest is far less satisfactory, depending on fewer drawings, and with a greatly reduced diameter and enfeebled aspect; and of the exact connection between Fig. IX. (or X., which seems to be an imperfect repetition of it, but the only corroboration I have), with VIII. on the one side, and XI. on the other, I am very ignorant: I can only feel assured that there were no great spaces intervening. On the whole, if the distorting effect of rotation performed in oblique spherical perspective, with the axis inclined about $25\frac{1}{2}°$ to the spectator, as shown in this diagram, is duly allowed for, with many other hindrances best known to those who have ever made such an attempt, it will be found that this series represents tolerably the chief features of a great part of the S. hemisphere.

The combination of the whole, however, into one polar projection, a mode of representation first attempted by Sir W. Herschel, and subsequently adopted by Beer and Mädler, I

* The night of a splendid meteor, whose path has been calculated by Mr. Herschel. It was nearly vertical in London, but here low in the E., and not far from Mars, so that I should have seen it to advantage had I not just left the telescope. All I could catch was its train descending towards the horizon; but a person who was with me saw it first ascend a short way and turn over in a narrow parabola. The light was very vivid.

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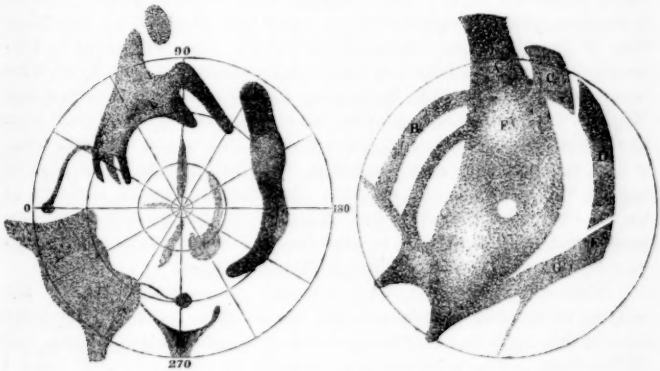
found essential to explain and reconcile many of my figures; and as the mode by which I obtained my diagram may possibly be serviceable to some brother amateur who may have been engaged in a similar study, or may be of use at some future opposition, it may be well to describe it. A circle cut out in cardboard, and divided round the edge into twenty-four hours, numbered (like those of Right Ascension) from W. by S. to E., is intended to represent the visible portion of the planet, viewed with the S. pole in the centre. This is capable of being turned on its axis within a somewhat larger circle drawn on another piece of cardboard, and divided by radii from the common centre into sections, three of which coincide with two of the hour-divisions on the moveable circle; each, therefore, corresponds to forty minutes of time; and as, fortunately, the rotation of Mars exceeds that of the earth by very nearly this quantity,* each of the divisions on this outer circle in succession, reckoned the opposite way to the hours on the inner moveable circle, indicates the position of the observer's eye on each successive night as long as the circle lasts, that is, for thirty-six days; but as the whole series of observations much exceeds this period, three other circles are drawn just outside of it, one beyond the other, which carry forward the series of days successively in turn from Sept. 16 to Dec. 20. Any day and hour, when a satisfactory sketch was taken, being then fixed upon as a standard, as for instance, Nov. 6, 8h. 45m., the moveable card representing Mars being so set as to have that hour coinciding with the given day in one of the outer circles, will stand in a right position with respect to any other day in all the four circles, at the same hour: for any earlier or later time of the evening, the corresponding hour-mark on Mars (the moveable card) being brought opposite to the standard day (Nov. 6), the diagrams will be set correctly for that time for every day in the series. Sketches taken at any time may then be transferred to the moveable card, in that peculiar conventional kind of projection which is used in similarly constructed maps; and though the distortion will be very great, identification, the chief object, will be attained. One consideration only interferes with the simplicity and facility of this plan—the orbital movement of the planet during a long series of observations, in consequence of which the position of the apparent centre of the disc will be somewhat altered; but this may be allowed for by constructing a little table, by which a correction may be applied to the hour of observation. Nov. 6 being fixed upon as zero, this correction fortunately proved always subtractive; it amounted to 43m. on Sept. 19, and 37m. on Dec. 20.

* The exact duration of the solar day and night upon Mars is fixed by Beer and Mädler at 24h. 39m. 35·7s.

By this mode of comparison I soon became aware of a greater degree of imperfection in my sketches and uncertainty in the judgment of my eye, than I should have otherwise expected, and I was enabled to clear up several points that might otherwise have caused ambiguity. The result is a very rough approximation, without any claim to correctness in detail; but as it was the fruit of four separate attempts of combination, all agreeing tolerably in essentials, it is given here, partly as the means of reference and of connecting the diagrams, and partly as an entirely independent, however inferior, deduction, for comparison with the similar S. polar projection of Beer and Mädler, of which a reduced copy is added.



BEER AND MÄDLER. WEBB.

The principle I have usually adopted has been to enter every portion as dark, which was ever so seen, though at other times it may have been luminous, on the ground that, reasoning from analogy, the surface of water, or marshy land as suggested by Beer and Mädler, would be less reflective than the upper illuminated surface of clouds or vapours, and that the dark spots would therefore be probably the more permanent features. It has been already stated that one portion of the hemisphere is much better delineated than the other; this, adopting Beer and Mädler's notation (though they reckoned from a spot which I never clearly made out), lies between long. 30° and 240°; while the configuration from 270° to 30° is especially uncertain, and may be materially wrong.

Although the first impression is not that of much resemblance, with careful attention a considerable similarity may be made out, as to general arrangement, between my figures and planisphere, and those of Beer and Mädler. For instance, the

spot I have marked A, and which usually appeared like a great half-opened fan of darkness, is evidently the same with that in Beer and Mädler, intervening between long. 30° and 90°; the long canal B is easily identified; my C corresponds with their sloping spot between 90° and 120°; D agrees still better, E forming, I believe, the end of their long leech-shaped spot; F may be recognized between their 30° and 90°, in lat. 30° to 60°; and other less certain correspondences may be traced or fancied. On the whole, we may conclude that the general permanency of the dark markings may be considered as satisfactorily established merely from these two sets of observations, even if De la Rue and Jacob's drawings did not, in part, lend their powerful aid. But though this independently-formed inference appears satisfactory, I have the pleasure of knowing that it has also been deduced by Secchi, with the great achromatic at Rome, and by our own countryman, Mr. Lockyer, who bears most honourable testimony to the accuracy of Beer and Mädler.* Whether, therefore, we are correct in supposing that the globe of Mars is occupied by land and water like our own, which is certainly very possible, or whether the difference of aspect is due to materials which only bear a certain analogy to them—for which belief, too, reasons might be adduced—we may consider the fact of a distribution of his surface into two permanent divisions as sufficiently ascertained.

Nevertheless, with this general resemblance there are tokens of special differences far too wide to be comprehended in any fair margin of allowance for terrestrial impediments and difficulties. The weather was usually so unfavourable that I seldom saw as well as the defining power of my instrument would warrant; and other eyes and hands might have otherwise viewed and represented what I did see. Still, mere inspection will make discrepancies evident which must have had their origin beyond our own atmosphere, and which no amount of blundering on the part of any one will serve to explain. Here, then, we seem to find indications, not to be mistaken, of an atmosphere surrounding Mars, charged with vapours as dense and agitated by currents at least as extensive and as rapid as our own.

This—the second point to which my attention had been

* The very beautiful series of drawings by this observer, exhibited at the last meeting of the Royal Astronomical Society, and destined for publication in its Memoirs, while they fully corroborate my own in a general sense, and complete their deficiencies, are much superior in that minuteness of detail into which a 6-inch object-glass would enable him to penetrate further than myself. A novice might perhaps be surprised at this assertion; but half an inch in the diameter of an object-glass is of material importance—the brightness of the image varying directly as the *square* of the linear aperture. Mr. Lockyer s glass possesses therefore one-sixth more light than mine.

directed—appears to be satisfactorily cleared up. Without seeking confirmation from the opinions of Herschel and Schröter, or referring to the obvious deviation from the forms given by Beer and Mädler, the conclusion would naturally follow from my observations alone. The reader may notice several instances of diversity, due probably to this cause; but two may be especially pointed out—the varying aspect of the north or narrow end of the dusky fan, which frequently and unmistakeably appeared pointed, but occasionally more open, especially in Fig. V., on one of the finest nights of definition; and the contrast between Figs. XIV. and XV., from which, as both were careful observations, it is fair to conclude, either that the narrow isthmus* crossing obliquely the dark spot was laterally moveable, or that in the latter instance the west end of the spot (E in the planisphere) was temporarily obscured. Still, were this dependent merely upon my own testimony, I might feel less confident, but Lockyer's most careful observations, corroborated by Dawes, have led him to the same inference; Lassell has found recurring phases so far from uniform as to infer "the transit of clouds of great extent, density, and variety of form;" Groves had come to a similar conclusion; and Phillips, from a comparison of his own drawings with those of the Earl of Rosse and Lockyer, is even led to entertain "serious doubts whether any of our drawings of those" southern "parts are much to be trusted as representing permanent physical boundaries. Nor should this," he adds, "be thought surprising; owing to the high inclination of the axis of Mars to the plane of his orbit, the regions round each pole are presented alternately to the sun through periods somewhat less than our whole year. The effect is seen in the vast outspread of snows round the cold pole, and the contraction of those white sheets to a small glittering ellipse round the warm pole. The enormous transfer of moisture from one hemisphere to the other while the snows are melting round one pole and growing round the other must generate over a great part of the planet heavy storms and great breadths of fluctuating clouds, which would not, as on the quickly rotating mass of Jupiter, gather into equatorial bands, but be more under the influence of prominent land and irregular tracts of ocean."

* This division between D and E does not appear in Beer and Mädler: it may be doubted whether from want of optical power: with me it was a frequently recurring feature, traceable more or less distinctly in six sketches between October 9 and November 24. When Fig. XV. was drawn, I was inclined to believe that a steadier air might have shown another bright but very narrow partition just to the right of it. November 17, when the figure was intermediate between XIV. and XV., a similar impression recurred, and even a surmise of another bright longitudinal streak connecting the two oblique ones; but these additions were extremely uncertain.

The contraction of the snow was very obvious in this series of observations, and will be traced in the drawings if they are examined in the order of *time* and not of *position*. Aug. 14. I had caught it even with a power of 55. Sept. 29. I thought it "much less conspicuous." Oct. 8. It was a "very minute speck." Nov. 4. I estimated it, from memory, at not more than 1″·5. The sharp definition of the disc that night permitted me to see with a power of about 300, what I had seldom been able to satisfy myself about, that the white ellipse was all within the limb, and as I believed not even in contact with it. The following night I noticed that the snow was not more than one-twentieth of the diameter (afterwards found to be 17″·5), and could not exceed 1″. With regard at least to the region of the dusky fan, and the antarctic circle, I think it appears that there was considerable more open sky in Mars in 1862 than in 1830.

Some observers have noticed a luminous border around the limb, and considered it as an indication of a dense atmosphere. This never caught my attention. Nov. 4. "I looked for a luminous ring round the limb, but could see none. The great spot (Fig. VI.) extended close to the limb, if not to absolute contact." Nov. 5 and 6. The markings in general reached the limb, and there was no luminous circumference. Dec. 10. Fig. VII., "The darkness of the end of the band near the pole is decided close to the limb." At other times I have thought that the spots became much less visible near the edges of the disc, as was usually remarked by Beer and Mädler; but it is not always easy to distinguish between perspective foreshortening and atmospheric obscuration.

Nov. 22. A bright border, as in Fig. XIII., was repeatedly suspected to attend the N. edge of the dusky band G., then lying centrally across the disc. It was, however, much less luminous than the snow-spot. It will be observed from the drawings that on this side of the globe there were repeated traces of faint shadowy markings in the N. hemisphere. Nov. 24. Fig. XI. "There seems to be a large amount of minute detail over the N. part of the disc, quite out of my reach: the whole is painfully woolly, though the limb is clear."

Oct. 11. I noticed for the first time a patch of bright green light, occupying an arc of 40° or 50° S. from the equator along the *following* limb, or terminator. I saw it again, more or less, on several occasions in the course of the next month, and probably might have perceived it before, had I more frequently used the higher powers, which almost exclusively rendered it visible. I was prepared for nothing of the kind, and had not thought of Mädler's similar observations in 1841 with the great Dorpat achromatic. It is probably merely an optical deception, but nothing of this kind should pass unnoticed.

In concluding this fragment, let me express a hope that the whole subject of Areography may shortly receive that more satisfactory illustration, of which it is certainly capable, from a diligent and extended collation of ancient and modern delineations. This has never yet been accomplished; and, from the number of observers during the late opposition, it is more practicable than at any former period. Much interest could not fail to attach to a careful monograph of a globe in many respects so closely resembling our own.

DOUBLE STARS.

An interesting communication with which I have been favoured by Dr. Dobie, of Chester, the possessor of a very fine $5\frac{1}{2}$ inch object-glass by Cooke, has enabled me to make a valuable addition to our list of Double Stars. The *pointer* on this occasion is β *Cassiopeæ*, the preceding, or in its present position the uppermost, star in that constellation: the finder will include in the same field with this star a small open pair, lying at a short distance $s\ p$. Each of these is double. The preceding one is

118. Σ 3057 (which in astronomical notation implies the double star so numbered in W. Struve's Dorpat Catalogue). 3″·64. 299°·53 (1832·29). 7·2 and 9·3 of Σ's scale of 12 magnitudes, which in Smyth's, of 16, would be about $7\frac{3}{4}$ and $10\frac{3}{4}$. Yellowish and ash-colour. Mr. Knott, who has obliged me by a careful examination of these objects, gives measures so closely accordant—3″·732 and 298°·55 (1863·52)—that the object seems merely an optical one. The other pair is more interesting:—

119. Σ 3062. The distance and angle have here rapidly varied, Σ giving 1″·25 and 36°·7, 1823·81; 0″·41 and 132°·62, 1835·66; 0″·49 and 157°·9, 1837·78:—Dawes, 0″·954 and 193°·43, 1841·86:—Mädler, 1″·05 and 220°·73, 1846·53:—Knott, 1″·444 and 265°·59, 1863·52 (the results, however, of a single night, and the distance possibly rather wide). This is, therefore, a binary system with a rapid motion, whose period, according to Mädler, will be completed in 146·83 years. Both stars Σ makes yellow; his magnitudes are 6·8 and 7·9: Knott gives 7·5 and 8.

As these two pairs both lie in the same field, and can both be seen double, with a power of 110 in his instrument, Dr. Dobie justly observes that they form a nice and very easily-found test for moderate-sized telescopes. He could see the whole with an aperture reduced to $3\frac{3}{4}$ inches.

Nearer to β *Cassiopeæ*, in fact the nearest object in the finder *s*, a very little *f*, I have noticed a very curious and beautiful little triangle of 8 mag. stars, suggesting strongly the idea of real juxtaposition in space, and consequent connection.

70 (*p*) *Ophiuchi* (42 of our list). Krüger, the great investigator of this star, from further observation prefers a parallax of 0″·162, subject to an uncertainty of 0″·0071, inferring a mass in the system 3·1 times greater than that of our sun, and a distance which light would traverse in 20·1 years.

OPTICAL DECEPTION.

The evening of July 27, 1863, had been cloudless, but hazy, with flaring and fluttering definition. As night advanced, however, it improved, and towards 11h. the discs of the stars came out finely: about this time, in endeavouring to meet with the beautiful triple star ϵ Equulei (which has no place in our list, from the difficulty of finding it from description), I came across a 6 mag. star with a close 8 or 8½ mag. companion, at about 1″·5 and 330°, both discs being very nicely defined. Thinking that this might be an object of W. Struve's, which I believed to exist in that quarter, but had never seen, I looked carefully at it, and continued my search, turning to a similar star in the field of the finder, some 2° distant. To my great surprise this had the same appearance. I tried a third; they were all alike. I at once turned the eye-piece (an achromatic combination by Powell and Leland, giving a power of about 300) round its axis; but the images remained unchanged. I then turned the object-glass one-third round; the companion was still there — I fancied at first somewhat altered in angle, but further examination proved that I was mistaken; and a turn of another third made no difference. A star not far from Al Tair gave the same result, perhaps less distinct. I looked to the west towards Hercules; still something of the same kind came before me, though not so clearly. I returned to my first three stars; in each case the attendant was still perceptible, though much less obvious, and apparently fading away: while occupied among them, I came unexpectedly across my intended object, ϵ Equulei; and here the beautiful and black division of the close pair at once satisfied me that neither the eye nor the instrument could be the cause of this singular deception. I regretted that its short continuance, and my own haste, prevented me from testing it more fully on other stars, and with other eye-pieces, but as to what I did see, no doubt remained. During an experience of many years, I cannot remember a similar illusion, excepting, perhaps once, with a single star, and even that may be questionable. It may possibly be referred to some unusual condition of atmosphere, producing, apparently, for a short time, something like double refraction in a vertical plane. Similar

effects, it is well known, are frequently perceptible in looking at distant shores or vessels across a considerable intervening surface of water—a species of *mirage*, of which I was a frequent spectator at Clevedon during the summer of 1846, especially in using a little hand-telescope.

NOTES ON THE HORNED PHEASANT.

BY R. C. BEAVAN,

Lieutenant Bengal Est., Member of Asiatic Society of Bengal.

HAVING, during a two years' residence at Darjeeling, in the Sikkim Himalaya, had many opportunities of observing the habits of *Ceriornis Satyra* (*Satyra melanocephala* of Blyth), I take the liberty of adding a few remarks to the account published in the INTELLECTUAL OBSERVER for September.

I have seen them both in their native wilds and in captivity, in fact have often been after them gun in hand, attended by a single trusty Nepaul shikaree (sportsman). I have generally found them on the steep forest-clad slopes of the mountains, at an elevation of from 6 to 9000 feet above the sea. They generally prefer the neighbourhood of water, but are, as far as my experience goes, always found among the densest underwood, and where the greater part of the vegetation consists of oak, magnolia, ilex, etc., and the other trees of that zone. Seldom seen in trees, except when disturbed by a dog, on hearing a human footstep they invariably run if they can, and it is anything but an easy matter in Sikkim to get a fair shot either at these or any other of the game birds that inhabit that country. When they do rise, they always fly down the side of the mountain, and the momentary glimpse one gets of a scarlet object between the trees, flying very rapidly, is to a man who perhaps for some hours previously has been toiling on hands and knees, and creeping through prickly bushes as silent as possible, under such circumstances anything but satisfactory. Shooting under such difficulties is therefore but little followed up by the Europeans; but those who want skins of birds, or game for the table, generally hire a native, either a Lepcha or a Nepal man, and they, by lying close near the known haunts of the birds, and imitating their call, draw them within shot.

These birds are generally found in pairs. The only time of year that even the natives can get at them is in the winter months, when the underwood is not so dense as at other times. The usual plan of capturing them is by making a low hedge, of about three feet high, of bushes, extending down the side of a hill, like the sides of a triangle with the base open. These

sides gradually converge until near the apex, where small gaps are constructed, each armed with a small noose. The birds are then gradually driven by men on foot—simply walking in line towards the base of operations I may call it—and the birds running on, instead of attempting to fly, run through the openings, and are caught in the nooses.

A curious fact with regard to this mode of capture remains to be noticed. The proportion of males to females are generally four or five of the former to one of the latter.

The birds are then brought into Darjeeling for sale, and fetch about 4s. each if it happens to be a dry season, but generally more. I have seen them sold at 2s. each. Early morning or in the evening are the times to go after them, the former preferred by the natives. They are then heard calling on all sides, and by dint of severe crawling and creeping one has the chance of a shot, which as likely as not will be at the bird running. The sportsman must avail himself of the very first glimpse of the bird to fire, or he will not be likely to see it a second time.

The lowest ranges of these mountains are inhabited from the plains to 3000 feet by the jungle fowl (*Gallus ferrugineus*); from 2000 to 6000 flourishes the Kallege, or Black Pheasant (*Nycthemerus melanotus*), and the Tree Partridge (*Arboricula rufogularis*), commonly called the Peura, or Pura; from 6000 to 9000, the Horned Tragopan, which is called "Moonal" by the natives; and higher still the Three-spurred Pheasant, and a larger species of Pura. Higher still again, in the region of the snows, is found the Himalayan Snow Pheasant.

Whether the Purple Moonal exists in Sikkim I am not able to say, having never seen one. The natives, however, on hearing my description of the bird, say it does.

The above are all the game birds of the pheasant and partridge tribe found, as far as we know yet, in Sikkim; but no ornithologist having yet followed Dr. Hooker's example, and penetrated into the interior of the country, the fauna of it is only known by the collections made by native collectors employed by B. H. Hodgson, Esq., and others.

The other game birds I have noticed are a species of solitary snipe, and the common woodcock.

Ducks are found in the valleys on or near the streams, the course of which they follow up from the plains.

Immense flocks of duck, geese, cranes, and other wading birds of nearly allied tribes, are seen at various times of the year passing high overhead *en route* from the plains of Bengal to their inaccessible breeding places in Thibet.

They do not appear to alight in Sikkim, but when once fairly started from the plains, to fly straight to their destination,

generally by night. The lakes and marshes of India, during the cold weather, abound with these birds, which about April and May commence their migrations to the colder and apparently inhospitable climate of the Trans-Himalaya.

OAKHILL, TORQUAY, *Sept.*, 1863.

THE NEW BRITISH SAND-GROUSE.

(PALLAS'S THREE-TOED SAND-GROUSE—*SYRRHAPTES PARADOXUS*).

BY THOMAS J. MOORE,

Corresponding Member of the Zoological Society of London; Keeper of the Derby Museum, Liverpool.

To the students of any department of natural history a new or rare species is always an interesting subject; if it be beautiful in colour, or remarkable in form, the interest is proportionally increased; and if the family as well as the species be an addition to the fauna of his own country, that interest becomes very great indeed.

The ornithologist feels all this at least as keenly as any other naturalist, and his feelings are largely shared by very many, who, though not professed naturalists, yet delight in the wonders and beauties of nature.

The recent occurrence in Britain of numerous specimens of a very handsome bird allied to the grouse kind, and which has only within the last year or two been met with out of its native haunts of Central and Eastern Asia, is a case in point. Here is a bird recently new not only to England but to Europe, chaste and elegant in colour, and certainly most remarkable in form, and no other species of the same family has been known to visit the British islands. Some account of its history, of its occurrence in our own country, and of its structure and relationship, will doubtless be interesting to the readers of the INTELLECTUAL OBSERVER, and particularly so to such of them as are given to ornithological pursuits.

This bird, then, was first made known to naturalists in 1772 by Pallas, a learned and zealous German zoologist and traveller, in the service of the Empress Katharine. He appears, however, to have seen, at that time at least, only a single and not very perfect specimen, brought to him during his travels in Tartary, by one Nicholas Rytschkof, who obtained it in the Kirghiz steppes. Pallas published a figure and description of it under the name of *Tetrao paradoxus*, but without giving any information as to its habits, farther than that it was met within

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the sandy deserts about Dshibel Mamut. In calling it a *Tetrao* he followed the arrangement of Linnæus, who included under that generic term both the true grouse of high northern latitudes, and the widely different sand-grouse of the hotter parts of the Old World, with which the *paradoxus* is most nearly allied.

Temminck, early in the present century, proposed the generic term *Pterocles* for the various species of sand-grouse, and, shortly after, Illiger separated from these the single species under consideration, and called it *Syrrhaptes paradoxus*, the name by which it is now recognized by ornithologists. The English name of Pallas's Three-toed Sand-grouse, which has since come into general use, commemorates the name of its discoverer, and refers to one of the peculiarities of its structure (that of its feet), which distinguishes it from all the species of *Pterocles*.

M. Delanoue and Dr. Eversmann appear to have been the next travellers who met with the *Syrrhaptes*, and who published their observations. M. Delanoue describes their walk as slow and laboured, and their flight rapid, direct, and elevated. "The nest is composed of the down of grasses, and placed among sand and stones under a bush. The eggs are four in number, of a *reddish white* colour, spotted with brown. The female quits her nest only at the last extremity. The Kirghiz call these birds *Buldruk;* and the Russians, *Sadscha.*"

Dr. Eversmann states that the *Syrrhaptes*, in the western part of its range, never passes further to the north than latitude 46°; but that eastward it ranges into higher latitudes, being found on the high steppes of the Southern Altai Mountains, on the uppermost course of the Tschuja, in the neighbourhood of the Chinese outposts, where the Mongols call it *Nukturu*.

Skins of these birds have since found their way, at rare intervals, to various public and private collections, from the Gobi Steppe, from Lake Baikal, and from Bucharia; but nothing further became known of their history or range until the summer of 1859, when the first-recorded European specimens were obtained. We next hear of them as being brought, both alive and dead, in prodigious numbers, to the markets of Pekin, from whence several lots were brought alive to England and deposited in the Zoological Gardens of London. Finally, during the present summer, there has been quite an irruption of them in various parts of the country. As the propriety of including this species in the list of European birds rests upon the instances recorded in 1859 and in the present year, it is quite worth while to state them in some detail. Before doing so, however, it may be well to note that Prince Charles Lucien Bonaparte included it in his *Geographical and Comparative List of the Birds of Europe and North America* (published in

1838), as inhabiting Eastern Europe. He at the same time separated the species of *Pterocles* and the *Syrrhaptes* from the true grouse, as a separate family, which he named *Pteroclidæ*. In a subsequent list he omitted the *Syrrhaptes*. Again, with instinctive pertinacity, he added it to the *Catalogue des Oiseaux d'Europe*, published by Parzudaki, the Parisian naturalist, in 1856, but modestly accompanying it with a query. Even this was too much for certain severe ornithological critics, who insisted upon the warrant for its appearance at all being brought into court; and Bonaparte, not being able to produce it, had to abandon the cause of his client.

In 1859 this vexed question was finally set at rest. In July of that year a very fine adult male bird of this species was brought to me in Liverpool, by Mr. Thomas Chaffers, on whose farm, near Tremadoc, it had been shot on the 9th of that month, and was still in the flesh. My first impression was that it had been imported alive, and had escaped from confinement. A moment's examination disproved this most thoroughly; for all birds of the game kind are especially impatient of confinement, shy, and wild, and when imported are always in excessively dilapidated condition, owing to the violent manner in which they knock themselves about in their attempt to escape from confinement or the observation of man. The scalp is generally torn nearly off the head, the wing and tail feathers are broken, and the whole plumage is draggled and dirty. To such an extent is this the case, that there are few more sorry-looking scarecrows than newly-imported birds of this order, and they do not recover their good looks until they have moulted. Here, however, was a bird as nearly perfect as could be. The plumage was unruffled; the delicate prolongations of certain feathers of the wing and tail, especially liable to be damaged, were unbroken, and the whole plumage was beautifully smooth and clean. It was one of three birds observed by a labourer named Quin, on a field of loamy sand, where he was engaged scuffling turnips. His attention was drawn to them by hearing a peculiar "chattering, whistling" noise, and having a gun near at hand, he succeeded in shooting one, the other two flying away, at a height of thirty or forty feet, directly eastward across the river Glasslyn into Merionethshire. They were never seen in the neighbourhood before or after that time. The crop of the one killed contained rape or cole-seed, and seeds of the furze, as kindly determined for me by Dr. Collingwood, Lecturer on Botany at the Liverpool School of Medicine.

Early in the same month, but the precise day unfortunately not stated, a very beautiful male bird was shot in the parish of Walpole St. Peter's, in Norfolk, about two miles from the Wash. This bird is now in the Lynn Museum, to which it was

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presented by the Rev. R. Hankinson. At least one other was seen about the same time in the same neighbourhood. A third specimen, also an adult male, was shot on the 23rd of the same month near Hobro, in Jutland. This has been preserved in the Museum of the University of Copenhagen. Finally, a fourth specimen, stated to have been one of a pair observed in the Dunes near Landvoort, in August, 1859, was killed in the beginning of October following, and is now in the collection of the Zoological Society of Amsterdam. That all these birds belonged originally to one flock would seem highly probable. One most competent witness (Mr. Alfred Newton) has seen each of the captured specimens, and declares them all to possess the extraordinary filamentous appendages in nearly perfect condition. The two British examples were fully recorded in the *Ibis*, a scientific journal, exclusively devoted to Ornithology, and the Tremadoc specimen was immediately stuffed, and exhibited before the British Association at Aberdeen, and subsequently before the Zoological Society of London, besides being noticed in the *Zoologist*. Not the slightest attempt has been made to cast a doubt on their having been genuine wild specimens, which had from some unaccountable cause strayed far from their native haunts.

No living specimens had at that time been known to be imported to Europe; indeed, it would be hard to name a more difficult place than their then known habitat from whence to import any object, living or dead; and no person ever pretended to have lost any. Their claim, therefore, to a place in the European and British lists as rare visitors was thenceforward regarded as well-founded.

As *rare* visitors most certainly, yet not quite so rare as until the present year was most naturally supposed; for during the present summer a prodigious number have visited our shores, as the following list will show. The date where given is that when the specimens were observed:—

May 22. A male and female killed out of a flock of about fourteen, at the Isle of Walney, North Lancashire.—Recorded in the *Times*, May 26, by Mr. Schollick.

May 22. Two killed out of twenty at Eccleshall, Staffordshire.—Mr. Yates, in the *Times*, May 28.

May 29 or 30. A very fine adult male, weighing nine ounces and a-half, and in perfect plumage. Recorded by myself in the *Times*, of June 6, as having been killed at Perth, but which I subsequently ascertained was shot at Hoylake, on the coast of Cheshire, where one other was seen.

June 2. A male and female shot near Farnsfield, Notts. Immature eggs of the size of small peas were found in the female. Both birds had been feeding on two or three varieties

of grass seeds, and the leaves of clover. Two others seen.—The *Field*, June 6.

May —. A male and female shot out of twelve or fourteen observed feeding in a grass field within a mile of the Sheffield Moors. (They were erroneously considered to be *Pterocles setarius*, but the description given, "cream-colour and spotted, with very remarkable feet, not unlike a rat's hind feet," proves them to have been *Syrrhaptes*.)—C. Rawson, the *Field*, June 6.

May —. A specimen shot at Royston, Herts, forwarded to Mr. Gould, the eminent ornithologist.

May —. "*A few days before Mr. Schollick's letter appeared in the Times*," three specimens were shot near Rothbury, in Northumberland.—W. Wilkinson, in the *Field*, June 13.

May 28. Seven made their appearance at Thorpe, Suffolk. "They were observed to come from seaboard, and apparently were compelled to alight on the first landing-place, the beach, through fatigue." A female with immature eggs was shot, and seeds, apparently of plantain or *rumex*, found in the crop.—N. F. Hele, the *Field*, June 13.

May —. A bird of this species broke his wing against a telegraph wire near Lingen, Hanover, and was kept alive some days. A covey of eight was also found not far from Hanover, one of which was shot.—The *Field*, June 6.

No date. A male and female winged by M. Gätke at Heligoland, where they are living and doing well.—The *Field*, June 13.

No date. A brace killed from a flock of nearly a hundred (?) near Oswestry. Buffon and Wilson, Strand, London.—The *Field*, June 13.

No date. A female (?) killed out of a flock of seven or eight, at Eastbourne, Sussex.—C. S. Willes, the *Field*, June 13.

No date. Some shot on this coast, a few miles north of this place.—A. R. A., Boston, the *Field*, June 13.

June 6. A male shot on the sand links of Dornoch, Sutherlandshire. It was a solitary specimen, and "the person who shot it was attracted to the spot by an unusual din created by a number of terns breeding there. They swooped down upon the grouse, and persecuted it in every possible way as an intruder."—W. A. Macleay, in the *Field*, June 13.

June 10. A male and female shot on the beach; only these two birds found.—M. Dodman, Titchwell, near Lynn, Norfolk, in the *Field*, June 13.

June 11. Two brace more shot by the same.—The *Field*, June 20.

June 11. "Fifteen passed towards the south along shore; and yesterday twenty were seen near Thorpe."—N. F. Hele, Aldborough, the *Field*, June 20.

June 4. Eight or nine observed in a grass field at Wrax-

ham, fourteen miles from Yarmouth; three females and a male shot.—H. Stevenson, the *Field*, June 20.

June 8. A male shot on the Dunes at Yarmouth, and two others seen.—*Idem.*

June 9. About forty "flushed once or twice on the beach at Horsey, near Yarmouth, returning each time to the same spot, a sort of hollow in the sands." Fifteen were shot on the 10th, and two on the 11th. The birds in fine condition; their crops filled with grass seed, sand, and fine pebbles.—*Idem.*

June (?) 12. A single specimen killed near Balcombe, Sussex.—The *Field*, June 20.

June 16. A covey of thirteen or fourteen observed on a rabbit warren by the sea-shore, near Drumbeg, Donegal.—W. Sinclair, the *Field*, June 20th. Mr. Sinclair killed a male and wounded a female on the following day. "The captive seems quite contented, was curiously familiar from the first, feeds freely on canary seed, grits, groundsel, etc., and is fond of washing and splashing in a pan of water."—*Idem*, June 27.

May —. "A flock of sixteen or seventeen Pallas's Sand-grouse has remained in the salt-marshes near Teesmouth for several weeks, and only quitted us last week. Three were shot on the 13th ult.," and one subsequently, all males. "They showed every disposition to settle here, but only owe their temporary security to their being taken by our gunners for golden plover, which on the wing they somewhat resemble."—Rev. H. B. Tristram, June 15. The *Field*, June 10.

June 12. A pair killed at Horsey, Yarmouth.—A. W. Crichton, the *Field*, June 20. (These and another brace were served up at the annual dinner of the Acclimatization Society, July 1st, and were pronounced to be admirable by all who had the good fortune to taste them.)

June 7. A pair shot near Saffron Walden; "the crops contained nothing but tares, and the flesh, both in appearance and flavour, was very like that of the common pigeon."—G. Taylor, the *Field*, June 27.

June — . One shot out of a covey of four within three miles of York, and five from a covey of nineteen near Scarborough.—G. Wright, the *Field*, June 27.

June 8. A male shot from a covey of ten or twelve near Wick, Caithness.—H. Osborne, the *Field*, June 27.

June 29. A male and two females in very good condition shot at Mersea, on the Essex coast, on some ploughed land a quarter of a mile from the sea-shore. "They seemed to come direct across the German Ocean; I only saw the three. They pitched down within thirty yards of myself and men."—Quoted by C. R. Bree, M.D., in the *Field*, July 4.

June 30. Nine seen on the beach at Hunstanton, Norfolk; three shot the week previous.—F. Tearle, the *Field*, July 4.

July —. A specimen (the only one seen) killed near Forest Gate, Essex.—J. Withers, the *Field*, July 18.

July —. A pair shot on the coast at Nairn, Donegal.—M. B. Cox, the *Field*, July 18.

July —. A pair shot from a flock of thirteen on the sands at Slapton Ley, near Kingsbridge, South Devon. The birds were in good condition, and had fed sumptuously on grass seeds. H. Nicholls, Jun.—*Idem.*

June —. A specimen "caught in Renfrewshire seven or eight weeks ago, and has thriven well on hemp seed, and is now very tame."—The *Field*, August 1.

"Specimens of this bird have been obtained in 1863 both in Denmark and Sweden, and in May last a small flock was observed, out of which three were shot, flying over a fallow field near Nykopping, in Sweden."—An old Bushman, Sweden, July 31. The *Field*, August 15.

May 28. Two specimens in fine condition shot out of a flock of twelve or fifteen at Munchals, near Aberdeen; crops filled with turnip and grass seeds.—*Edinburgh New Philosophical Journal*, July, 1863.

June 23. A male picked up dead at St. Agnes, one of the Scilly Islands.—E. H. Rodd, in the *Zoologist* for August, p. 8682.

June 10 or 12. A female shot close by the Land's End.—E. H. Rodd, in the same.

May 29. A female killed against the telegraph wire at Box Hill, Surrey; eight seen at Pevensey the day previous.—D. Dutton, *Zoologist*, p. 8683.

May 26. A female shot near Aldershot Camp, and another observed. A day or two after another female was killed out of a covey of nine.—M. A. Matthews, *Idem*, p. 8684.

No date. Two males killed near Barnet. E. Newman, *Idem*, p. 8685.

I have been thus particular in enumerating the places and date of occurrence in order to see what light they would throw upon the subject; and, although it is to be regretted that the precise date has not been given by all the writers quoted, yet enough has been done to show the broad features of the case. Their route across the Continent appears to have been much the same as in 1859. There is no possibility of ever knowing their exact points of departure, but a course very little north of west from the wide range of country they inhabit would bring them to those parts of the Continent which some of them, at least, have passed, and a continuation of the same direction would land them on the coasts of Norfolk and Suffolk, where the greatest numbers appear to have been met with.

If all the specimens observed commenced their westward journey in a single flock, they certainly broke up subsequently into several smaller ones, for the flocks observed in Sweden, Heligoland, and Hanover consisted of a few individuals only. It is not possible to state, from the data given, what was the precise day when they first appeared this year in these islands. The whole arrival is much earlier than in 1859; M. Schollick's is the first published announcement, and also the earliest date precisely given. Mr. Tristram's statement that the flock at Stockton-on-Tees was observed "several weeks" prior to June 15th (the date of his letter to the *Field*) is somewhat indefinite. Mr. Wilkinson's statement that specimens were shot "a few days before Mr. Schollick's letter appeared in the *Times*" is more precise. It would have been worth while, however, to have hunted out, while the facts were fresh in remembrance, whether they were or were not shot before the 22nd, the day on which Mr. Schollick's were killed. Whatever the dates of arrival, however, they speedily spread themselves over the country, but to the north more quickly than to the south. They were shot at Aberdeen on the 28th of May, but were not killed in Cornwall till June 10th or 12th. In Ireland they were observed on the 16th of June, and in the Scilly Islands on the 23rd. Their actual arrival was observed at least on two occasions, but at an interval of more than a month, viz., May 28th on the Suffolk coast, and June 29th on the coast of Essex. Nearly a week before the earliest of these, specimens had been shot by Mr. Schollick on the western shores of England. Indeed, the rapidity with which they spread themselves is scarcely less remarkable than the fact of their reaching the extreme borders of the land; literally from Land's End to John o' Groat's, and from the coasts of Norfolk, Suffolk, and Essex in the east, to those of Lancashire and Donegal in the west; the British Islands would seem not large enough to hold them. That they found food of a suitable kind would appear evident from the number stated to have been in good condition; indeed, not one was said to have been otherwise.

The question as to the cause of these two unusual and most prolonged migrations, is a very tempting, but, I fear, insoluble one. What special circumstances have been in operation during the present summer and that of 1859, which never occurred before, to bring these birds to our shores during the very many years that attention has been closely directed to the visits of rare and strange birds? Of this only can we, I think, be certain, that the causes, whatever they were, originated in their own country rather than here. It is more reasonable to suppose that they were *urged* rather than *drawn* from their home; for what attractive power can we imagine to extend its influence

from here to Tartary? Again, whatever the influence might be, how special must have been its operation NOT to have acted upon other birds peculiar to the same country, for no other such visits have been recorded. The present summer has been remarkable rather for the scarcity of the usual summer visitors; the most unusual wanderers hither, besides the *Syrrhaptes*, are the Demoiselle crane, of North Africa, and some Canada geese; which latter, if the examples observed be not escaped birds, certainly came from an exactly opposite direction to the *Syrrhaptes*. On looking over the pages of the *Zoologist* for 1859, I find that the only unusual eastern bird which was observed during that year, was a specimen of the little bustard (*Otis tetrax*), shot near Oxford, in the beginning of October; but specimens of this species had been shot in England in several previous years, though never in the breeding season; and although it inhabits Tartary, like the *Syrrhaptes*, it by no means follows that any of these wanderers came from thence, for the species inhabits not only North Africa also, but is found as well in several parts of Southern Europe. One fact, however, connected with this species lets in a faint glimmer of light upon this obscure subject. M. Menetries states that these birds are very common at the foot of Mount Caucasus, and particularly so towards the shores of the Caspian sea; and near Baiku, he saw in December, immense flocks of these birds *going in the direction from east to west*. This looks like a migration in the direction of longitude, as surmised, in the case of some other birds, by Dr. A. L. Adams, a most observant Indian ornithologist. Now migration in the direction of longitude will differ from migration in the direction of latitude in this important particular, that the difference in temperature will, in the former, be so slight as to be scarcely appreciable, while in the latter it will rise or fall most rapidly; so that a migration from Tartary, in nearly the same parallel, will not meet that check, in respect of temperature, which would in a northern or southern direction at least exercise some influence upon its extent. Applying these considerations to the case of the *Syrrhaptes*, we yet cannot fail to wonder why their near allies, and our nearer neighbours, the European sand-grouse, have not moved westward too, but, on the contrary, have literally allowed the *Syrrhaptes* to come over their heads! Strange too that these birds should have come in the breeding season, and that so far advanced!

Having now related sufficient to show the extreme interest attaching to the *Syrrhaptes* in a geographical point of view, it will be desirable to describe its structure and relationship a little more fully, to show that its physiological character are quite as remarkable.

The sand-grouse are strictly confined to the Old World, and

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consist of numerous species, some or other of which are distributed over the whole of Africa and the hotter parts of Asia; heat, as remarked by Swainson, being as essential to them as cold is to the true grouse. Two species occur in Southern Europe, *Pterocles alchata* and *Pterocles arenarius*, both of which range into North Africa and Western Asia, *but neither of which, nor any other species of the family, has yet been known to visit Britain*—a noteworthy fact when viewed in connection with these sudden inroads of a more distant species. A peculiar style and arrangement of colour pervade the whole group. The ground colour in all is a buffy or sandy hue. This is variegated with black, chesnut, and white or grey. The disposition of these colours varies of course in each species, but they are disposed in either more or less regular stripes or bands, or in spots or blotches. Large and conspicuous masses of colour, when they exist, occur on the under side of the birds. It will thus be seen that the colours and their arrangement are such as to make the birds as inconspicuous as possible in a sandy, arid country, and greatly tending to their preservation from birds of prey.

The type and form of structure is peculiar, and in *Pterocles* is pretty uniform. In size, the species vary from that of a wood pigeon to a turtle dove. The beak is moderate and compressed; in some very slender; the nostrils are placed near its base, and partly closed by a membrane, which is covered above by feathers; legs feathered in front to the foot; toes short and moderately robust; the hind toe small and elevated; tail more or less conical. In *alchata* the two middle tail feathers are lengthened into filaments; wings long, and the first two feathers the longest.

In *Syrrhaptes*, the only other genus of the group yet discovered, the beak is slender and diminutive. The first feather of the wing and the two central feathers of the tail are prolonged into a slender filament, extending two or three inches beyond the other feathers.

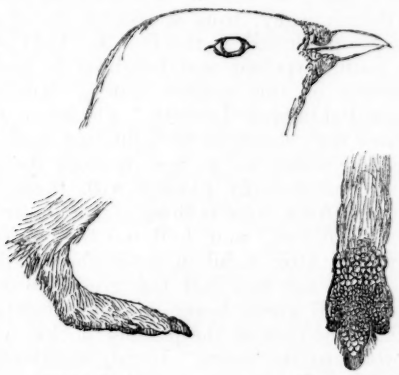
The foot is densely clothed with short feathers down to the claws, which are very broad and strong. *The toes are united together through their whole length*, and covered beneath with plates, which, when well worn, are nearly or quite hexagonal; when less worn projecting in a scale-like manner. The foot thus forms a strong solid pad, well secured from injury from the wearing particles of sand, or the sharp edges and rough surfaces of rocks. No other bird with which we are acquainted has the foot so solid and compact.

Total length from tip of the beak to end of the central tail feather, from 12 to 13 inches; length of wing from the carpal joint to the end of the second wing feather, $8\frac{1}{4}$ inches, the filament of the first feather extending $3\frac{1}{2}$ inches further; tail,

4⅓ inches; filament beyond, 3½; length of foot and middle claw, 1 inch; breadth of foot, half an inch; gape, half an inch.

The general colour of the male is pale buff, the head yellowish, the cheeks and throat rufous. The feathers of the back are barred with black, the breast is greyish, bounded with a belt of narrow black lines. A broad black patch, varying in length in different individuals, occupies the centre of the under surface. The sides and vent are whitish, the legs being of a duller white. The wings are tinted with grey, black, buff, and red brown. The tail feathers are barred and striped with black and buff, and are broadly tipped with white, the filaments of the tail and wing are black

The female differs from the male in wanting the filaments



Right Foot. Right Foot.

HEAD AND RIGHT FOOT OF SYRRHAPTES PARADOXUS.

of the wing, in having the head yellow, streaked with black, and the sides of the neck spotted with black. The black bars of the back are smaller and more numerous, and the yellow colour of the throat is separated by a narrow black band from the breast, which is grey.*

The skeleton of the *Syrrhaptes* is as remarkable as the external form. Mr. W. K. Parker, who has made a very special study of the osteology of birds, places the sand-grouse intermediate between the true grouse and the pigeon, and considers the *Syrrhaptes* the culmination of the Pterocline type of

* A fine plate of the male, female, and egg is being prepared for publication by Mr. Gould in the forthcoming part of his magnificent work, *The Birds of Great Britain.*

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structure, which, however, he looks upon *as of a very low character*. Not only do certain bones of the skull show a "marked struthious inferiority in the *Syrrhaptes*, but the sternum, which literally unites that of the ptarmigan with its counterpart in the pigeon, is inferior in one important point, not only to this but to the whole Pluvialine group. The heel, which is a mere rudiment in *Pterocles* proper, is absent in the *Syrrhaptes*, and the whole pelvic extremity is almost the counterpart of that of the Swifts in deficient growth. I believe that it would take a very clever anatomist to detect any difference between the wing bones of the *Pteroclinæ* and those of a typical pigeon."*

With respect to the range and habits of these birds, some important information was gained during the late war in China. Mr. R. Swinhoe, an ardent ornithologist attached to the staff of the British army, thus speaks of the *Syrrhaptes paradoxus* in a paper published in the *Ibis* for 1861:—"Your readers will be both surprised and delighted to hear of the abundant occurrence of this species during winter about the plains between Pekin and Tientsin. Flocks of hundreds constantly pass over with a very swift flight, not unlike that of the golden plover, for which we at first mistook them.† The market at Tientsin was literally glutted with them, and you could purchase them for a mere nothing. The natives called them *sha-chee*, or sand-fowl, and told me they were mostly caught in clap-nets. After a fall of snow their capture was greatest, for where the net was laid the ground was cleared, and strewed with small green beans. The cleared patch was almost sure to catch the eyes of the passing flocks, who would descend and crowd into the snare. It only remained then for the fowler, hidden at a distance, to jerk the strings, and in his haul he would not unfrequently take the whole flock. Numbers, however, were shot with matchlocks. When on the ground they were rather shy and difficult of approach, but on the wing they would sometimes dart within a few yards of you. They possess rather a melodious chuckle, the only note that I have heard them utter. The natives say that during the summer they are found abundantly in the great plains of Tartary beyond the Great Wall, where they breed in the sand."

The Hon. J. Stuart Wortley purchased above seventy living specimens in the market at Tientsin, and succeeded in bringing thirty-four alive to England. These he presented to the Zoological Society, Regent's Park. He states (in the Society's *Proceedings* for May 14, 1861), "on our voyage up

* Vide *Proceedings of the Zoological Society of London* for Nov. 25, 1862.

† Several of the observers of the *Syrrhaptes* in England, already referred to also at first mistook them by their flight for golden plovers.

to Tientsin, in the end of August, not a bird was to be seen; and as far as I could learn they had only just begun to appear at Tientsin when we arrived there, on our return, in the beginning of November. Their food must consist of the grain (millet) that covers the whole of that part of China, and I should mention that I fed them on millet the whole way home. The temperature at the time the birds first began to be seen was about 20° Fahr., and later on considerably lower; and on the day we finally steamed down through the ice, which covered the Peiho for fifty miles of its course, the temperature was as low as 10° Fahr., and the grouse were in large flocks on each side."

One of these birds, after its arrival in the Regent's Park, laid a single egg, which is now in the cabinet of Mr. Alfred Newton, by whom it was figured and described in the *Proceedings of the Zoological Society* for 1861, p. 397, pl. 39, fig. 1. Mr. Newton, who saw it a very few hours after it had been laid, says that the colour was then very brilliant, *brown spots showing warmly against a fresh sea-green ground;* a description differing in the ground tint from that given by M. Delanone. It was placed in an incubator, but was shortly after found to be cracked. The only eggs of the *Syrrhaptes* previously known to exist in any collection, were stated to have been obtained by Herr Radde, *in Eastern Siberia,* and are now in St. Petersburg.

Several living specimens were also brought home from China by J. R. Dyce, Esq., Royal Artillery, and were presented to the late Prince Consort, who had them placed in a portion of the royal aviary, specially constructed for them, and in every way adapted to their habits. Dr. Buckland, speaking of these birds, says that they have, in spite of every care and attention, never shown any sign of breeding. Mr. Bartlett believes they would breed in this country if allowed to remain undisturbed in a wild state, though they will not breed in captivity. The birds observed for so long a period near Stockton, seem to have had the best chance of breeding, but no discovery of eggs or young has yet been recorded. Possibly an egg or two may yet be discovered strung among the treasures of some cottage urchin.

In conclusion, I may remark that the genus *Syrrhaptes,* as far as yet known, consists of only one other species, which was discovered by Lord Lilford, by whom it was met with on the banks of the Tsumureri Lake, in the country of Ladakh. He obtained no information as to its habits, and only one other specimen came under his observation. It was described by Mr. Gould, in the *Proceedings of the Zoological Society* for May 14, 1850, and afterwards figured in his great work on

the *Birds of Asia*. It is of much larger size than *paradoxus*, being fifteen and a half inches in total length. It lacks the prolongation of the wing feathers, and the black colour on the breast; the colouration being otherwise different. Dr. Adams, of the 22nd Regiment, subsequently met with this species on the Salt Lakes of Ladakh, in August, 1852. It has also been observed by Captain Speke.

Finally, great and good service has been done in the cause of British Natural History by the *Field* newspaper, for the history of the occurrences of the *Syrrhaptes* would have been much less complete indeed, but for the notices which have appeared from week to week in the natural history columns of that journal.

[Since the above was in print, the following important communication has appeared in the *Zoologist*:—"This very beautiful and interesting stranger was first observed and shot here on the 21st of May, the weather being very fine, with a moderate easterly breeze. Each succeeding day, up to the earlier part of June, it was seen here in flocks varying from about three, five, fifteen to fifty, and in one or two instances even to a hundred. Out of these nearly thirty have been shot; the earlier birds being, with two exceptions, all very fine male specimens, the later nearly all female birds, every one of them in the most perfect plumage. After a lapse of a fortnight, viz., on the 22nd of June, six sand-grouse again made their appearance; out of these five were shot, all female birds, whose plumage no longer had that fresh and tidy appearance of the earlier instances; so that all through this abnormal and mysterious excursion of this species, they still adhered to the rules of birds on a regular spring migration, that is, the males forming the van, the finest old specimens coming first, after which the females make their appearance, and the rear being invariably brought up by weak, badly-developed or injured individuals of a shabby appearance."—*H. Gatke, Heligoland, July,* 1863, "*Zoologist*," *p.* 8724.]

THE MORAL FACULTIES OF BRUTES.

BY SHIRLEY HIBBERD.

In an attempt to establish some general conclusions neither new nor strange in reference to the respective spheres of operation of Reason and Instinct (Int. Obs., vol. iii. p. 436), it was held that the only determinable difference between man and animals is one of *degree* and not of *kind*. It is really strange that, after so much has been written and said on this interesting subject, it should be at all needful to prove that the faculty of reason is not given to man alone, but is shared by him in common with the brutes around him, but in a more liberal manner, as the result, in the first place, of Creative Will, and, in the second, of a superior organization. We are oftentimes so deeply and subtly influenced by prejudice that even the truth has the aspect of falsehood, and we renounce a doctrine rather because we do not like it than because we can prove it to be untrue. The doctrine of a community of reason between man and animals is just one of those which the mind is in haste to reject, and in such haste that it prefers not to find reasonable grounds of objection, though data may be close at hand, and in fact within man himself, who is the epitome of the creation.

But there can be no true progress in science unless we are prepared to receive truth as precious for its own sake; and when we begin to observe the habits of animals, and to reason upon the impulses of so-called instinct, we find them to be parallel in every sense to the manifestations of reason in ourselves. The range of brute faculties is by so much narrower than the range of human faculties as this or that order is farther removed from man by inferiority of organization; but the mind is of the same sort in both cases; there is but one mind, and of that animals share a sufficient part for all the exigencies of their life, and something more. Now it is worth asking, if it is possible to separate thought from moral feeling? if it is possible for a creature to think at all without also desiring to think truly and to do well? If the animal races share with man in the power of ratiocination, do they not thereby become, to a certain extent, responsible agents both before God and in the face of nature? We are often told that reason is given us to guide us to what is right, and we must not deny that reason is given to brutes for a similar purpose, and that, if they are not the victims of blind impulse, working wholly in the dark to ends of which they are ignorant, then there must be some-

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thing like morality in the animal kingdom, and it is surely worth an endeavour to ascertain what that morality is like.

If I call my pretty Fido, having perhaps missed him from my side for half an hour, I can tell by his reply if he is engaged in mischief, fun, or duty. Those who can hold conversation with animals can best judge what is likely to be the range of their moral feelings; but the most careless observers may take part in the investigation of this subject, for everybody has heard of and seen a "naughty dog." Now Fido knows exactly, as if he had learnt by heart a concise dog's catechism, what is (for him) right and what wrong. I have called him, and he has answered, not with a joyous snap and a bound to follow, but with a tardy snuffle and a slow approach, with his chin scrubbing the ground and his tail doubled the wrong way, and I know thereby that he has found my best carpet slippers and made a beginning of tearing them to pieces. Fido knows he has done wrong; he knows that I shall frown and scold, and that shame will follow upon misdeeds. I repudiate the word instinct while pondering on this event. There is nothing in it that agrees with the definitions of instinct, but I do see in it the glimmerings, and strong glimmerings too, of a power to distinguish between right and wrong; and when I have sufficiently punished Fido, I ask myself why punish him at all if he is not a responsible agent? He wanted amusement, and found it by gnawing the red roses and white lilies out of my fancy slippers, that were worked for me with so much care by somebody who loves Fido as much as I do; just as, when a boy, I found amusement in robbing Captain King's orchard, knowing all the while that I was doing wrong, and anticipating while I did it the nature of the punishment to be endured. But such general indications of moral sense will not satisfy those who come to the consideration of this subject with a burden of prejudices or a spirit of sceptical pride, and so I must ask such to believe that when I am sad Fido is sad, when I am in a spirit of rejoicing Fido's eyes sparkle as if with fire, and he catches my vein of humour and is ready to roll in the moss, gallop wildly through mire and brake, and by every look and gesture exhibit a thorough sympathy with all my moods, and sometimes somewhat of an anxiety to read my thoughts, as I try hard to read his, and flatter myself that I have succeeded perfectly. Now this sympathy between man and brute is an everyday fact: the timid rider puts the hunter out of heart, and he fails to leap fences that, with a confident rider, would be nothing to him. It is the strong sympathy subsisting between the shepherd and his dog, combined with the stern sense of duty which education has made a ruling passion in the breast of that dog, that are the secrets of their

co-working so successfully in the arts of shepherding; and were the dog a stranger to the monitions of the moral law, the sheep must be his prey and not his charge, for the first element of his life is a recognition of the distinction between right and wrong. So all through, so far as man allows an animal to share some part of his domestic life, there is a moral bond of unity, less strong perhaps than that which binds us together in the family and the city, but strong enough for the purpose, and limited only by the contracted capacity of the brute to appreciate the majesty of ideas.

The workings of maternal affection afford a familiar example of one of the finest moral qualities with which Almighty Wisdom has endowed the brute creation. We may call it instinct, but who can draw the line of distinction between the love of a bird for its young and the love of a human mother? In what quality of parental tenderness does the superior creature differ from the inferior? We see in both an anxious care—an anticipating of wants, assiduity which scarcely knows fatigue, devotion which cannot be chilled, constancy unfailing. They differ truly and vastly, but all the fine qualities of the loving woman, which painters and sculptors will endeavour to pourtray to the end of the world, have their counterparts in the heart of the dove, and we may any day learn from the solicitude of an animal for the welfare of its offspring something of the morality of the brute creation.

It would not be a difficult matter to enumerate all the several requirements of the moral law, and point to examples of their fulfilment, not adventitiously, but designedly and intelligently, by animals. But why do we speak of an "honest dog" and a "vicious horse"? It is because we see virtue in the one and vice in the other. But there are honest horses and vicious dogs, and as among men, so among brutes, the beauty of morality is illustrated by the ugliness of crime. All the higher orders of the mammalia exhibit various types of moral excellence as accompaniments to certain peculiarities of cerebral conformation. You know an honest dog the moment your eyes meet his; you will also know a scoundrel dog by his inability to face you, and his skulking gait and downcast, cunning look. Does the bull-dog betray any capability for high moral qualities?—his broad, flat head, his protruding ears, and his forbidding muzzle proclaim him a genuine savage. We should give up hopes of reclaiming such a brute were it not observable that in some instances, in which man and dog are inseparable companions, his master has the same type of head and muzzle, and is also a savage, and if we hope to reclaim the one, why should we not the other? Some men are born criminals, and so are some dogs and horses. Relative morality, like

relative intelligence, is, to a great extent, a question of race—it belongs to the blood; and as we can only hope to reclaim the bull-dog by breeding away from the type, so it is with the man—he will be a human bull-dog to the end of his days; but his children may be an improvement on the parent, and in the course of a few generations the vicious element may be overcome by something nobler.

A Lavater among animals would find it an easy matter to arrange all the higher orders according to their several degrees of moral excellence, according to their cerebral conformations, according to *à priori* considerations, and make but few mistakes. In the elephant, horse, and dog we have the noblest qualities and the noblest types of cerebral development. Faithfulness, courage, affection, and a spirit of unselfish honour are evinced in a remarkable degree by the best examples of these three subjects, and here we find the brain piled up above the sinuses, and the merely animal faculties subordinated to the intellectual, so that there is the capacity for sympathy with man, and the ability also for companionship. Mere intellect would not suffice to render these creatures so adapted for companionship as they really prove themselves to be, any more than cold wit without a spark of generosity will beget for any man much of the love of his fellows. It happens, too, that, as among men, the most intelligent races and the most intelligent individuals exhibit a higher average of virtue, so among animals the quick-witted, easily taught, receptive examples are, for the most part, more confidently trusted with our property and lives. The race-horse, a delicate creature, with a skin like a kid glove, and an organization so refined that he is almost separated thereby from other breeds of horses, frequently exhibits an ungovernable temper, except to the boy who strews his litter, and to him he is as a pet lamb, and may be coaxed with a whisper and flattered by a touch of the hand. But see him defying the strongest jockey at the starting-post to restrain his ardour, and trembling with nervous delight at the plaudits of the crowd, and who can deny that there are strong moral impulses mingled with a quick intelligence in that most enthusiastic of all animal natures?

It is not at all surprising that the animals on which man has most ardently bestowed his energies for their improvement should exhibit high moral qualities and a capacity for higher things than have been accomplished yet. Morality is avowedly an acquisition, though the capacity for it is an essential part of the nature. The rapacious tribes are evidently in a low moral condition, and will ever remain so, as the necessity of their organization and of the limited extent to which it is possible for man to influence them. But, amongst those that have been

most improved, there are differences of degree that sufficiently prove the fact that brutes have not only a physical and an intellectual, but a moral nature; for with some rewards and punishments are mighty engines for good and evil, and with others there is comparative callousness to both. Those who have travelled in old times by the diligence arriving at the Messageries Royale, in Paris, will remember that the white horses employed were of a very pugnacious breed, for no sooner were they liberated from their harness than they fought furiously, without a cause and without method, as Hibernian revellers are said to fight at Donnybrook fair. So those who have enjoyed an acquaintanceship with St. Bernard dogs will have observed that the immense generosity of their natures is such that they may be tormented by demoralized curs till their passions are roused by positive suffering ere they will put forth their strength in their own defence, and adopt the last resource of a forgiving spirit, that of punishing an adversary already completely in its power.

But what, after all, are the qualities that render animals useful to man as companions, protectors, servants, and friends, but those which are strictly in the category of moral excellencies, and capable of still more perfect development as races improve and the effects of education become hereditary? But it is also of importance to recognize the relationship of man and brute in this respect, first for the sake of truth, and second for utility. If we love truth, we shall see in the dog a faint foreshadowing of the highest object of the moral nature of man, for who can doubt that, in some sense, the dog worships his master? On the score of utility it is, at least, worth observing that moral qualities are transmitted by descent, and these should be thought of in selecting animals for the purposes of breeding, no less than qualities purely physical. If it be objected to the conclusions here so generally, and perhaps vaguely, and certainly hastily drawn, that it tends to degrade man to the level of the brute, the reply is, No: it cannot degrade man to be just in his estimates of the capacities of the creatures he makes subservient to his uses, for the first necessity of a moral existence is an admission of a difference between right and wrong, even though, in our mistaken judgment, what we pronounce right may, in the end, prove to be wrong. It may not be hurtful either to science or morality to humble those who deny to brutes any better guiding principle than a blind instinct, and it cannot exalt the brutes, for they are not yet so far advanced in intelligence as to read what is written concerning them. But if it be said that this doctrine is opposed to the truths of religion, I again say, No: because religion, even though it be paganism, has respect for truth as one of its

fundamental principles. As one who has hope in Christ I experience no shock when I discover traces of moral life in the brute, and rather feel a desire to praise God for having so multiplied his mercies as to give to these humbler sharers with me of physical existence a capacity for more happiness than is comprised in merely eating and drinking. I praise Him for making their breasts the abodes of sensations that lift them somewhat above the level of dead matter; and if it be his will that certain races, as horses and dogs for instance, shall improve morally, as well as physically and intellectually, I still see that man is to be the agent of their advancement, and that every step of their progress will be accompanied with benefits to the human race. Religion appeals most strongly and directly to the moral nature; but we may suppose at least that we possess a monopoly of religion, for we ourselves avow it *to be revealed,* and, if revealed, then the moral nature, whether in its crude elementary condition as in the brute, or its more finished, yet still imperfect (and how imperfect!) condition as in man, cannot educe the doctrine by any spiritual generation within itself. There may be the germ of some sort of adoration in the mind of the dog looking full in his master's face with a gaze of absorption, but it is of the same kind as the gaze of a savage at a fetish, and after all the dog worships the man; but it is man's privilege to worship his Maker, and to hope for everlasting union with the Divine Essence. *There* then is a distinction and a difference; but, while we take such comfort to ourselves, let us not trifle with the serious truths of nature, or take refuge in a purposeless pride when we have parted company with reason. A fair recognition of the relationships that exist between ourselves and the brutes may perhaps tend to the cultivation of a spirit of mercy in all our dealings with them, and help forward the day when man shall be at peace with himself and all around him.

ENTOMOSTRACA FROM GIHON.

BY THE REV. CHARLES H. MIDDLETON, B.A.

I INTENDED to have sent you a paper on certain Entomostraca from the pool of Gihon, but I find that the little creatures have been so thoroughly described by Dr. Baird that I can say nothing that has not been said before, and said much better. See *Natural History Review*, 3rd series, vols. iv. and viii. Still this short notice may prove interesting.

A quantity of dried mud from the upper pool of Gihon was sent to England by a friend of mine, Edward Atkinson, Esq., then attached as surgeon to the British Consulate at Jerusalem. It was addressed to Mr. Henry Denny, of Leeds; this was in the year 1858. The following year Mr. Denny sent a part of it to Dr. Baird, putting what remained into an aquarium, which he placed where it should receive as much sunlight as possible. Dr. Baird did the same with the mud sent to him, putting it into water on June 3rd. By June 10th many living creatures had appeared from the ova contained in the mud, and the articles I refer to in the *Natural History Review* contain full descriptions. A fresh parcel of mud from the same pool has since been received at the Philosophical Hall, Leeds, and the whole has for two years lain dry. This year, 1863, it has been placed in water, and has given birth to living creatures which, on reference to Dr. Baird's descriptions, I find to be identical with the species he has named, and with them grows a beautiful Chara. Thanks to the kindness of Mr. Denny, I have had full opportunities for examining the little beauties. Their season is now over; the mud will again be dried, and again next year be watered, when it is hoped the same interesting result will follow. Foremost among the living creatures produced is—

Branchipus eximiis. I have examined one male, two females. They bear a close resemblance to the British species, *Cheirocephalus diaphanus*, described in Dr. Baird's work on Entomostraca in the Royal Society's publications. *B. eximiis* does not attain the size of *Cheirocephalus*, being barely $\frac{3}{4}$ths of an inch in length. The elegant movements of the little creature, the constant waving motion of the branchiæ, and the bright dark eyes, in contrast to the transparent body and bright red of the intestinal canal, make this one of the most beautiful species of the class.

Estheria Gihoni. $\frac{3}{8}$ths of an inch in longest diameter. The brilliant red body, active movements, and transparent shell made this well worth seeing.

Daphnia Atkinsoni, Cypris Celtica, Cypris Orientalis, and

Diaptomus similis are all described by Baird. They bear close resemblance to British species. The shells of all were thickly planted, especially about the anterior portion, with Vorticellæ, who seemed to take advantage of the currents created by the movements of their hosts.

COMETS.

AN ACCOUNT OF ALL THE COMETS WHOSE ORBITS HAVE NOT BEEN CALCULATED.

BY G. F. CHAMBERS.

(*Continued from page* 255, *vol.* iii.)

279. In April a comet near δ Hydræ; in May another (the same ?) comet near π Leonis. In August it was situated within the circle of perpetual apparition.—(Ma-tuoan-lin.)

281 [i.] A comet appeared in September near κ Hydræ.—(Ma-tuoan-lin.)

281 [ii.] A comet appeared in December near *a* Leonis.—(Ma-tuoan-lin.) This might be the same as the preceding.

283. On April 22 a comet was seen in the S.W.—(Ma-tuoan-lin.)

287. A comet appeared near μ Sagittarii for ten days. Its tail was 100° long.—(Ma-tuoan-lin.) No month given.

290. In May a strange star was observed within the circle of perpetual apparition.—(Ma-tuoan-lin.) Whether a comet or only a temporary star is uncertain.

301 [i.] In January a comet emerged to the W. of β Capricorni, with a tail pointing to the W.—(Ma-tuoan-lin.)

301 [ii.] In May a comet was seen near either ω Capricorni or 110 Herculis.—(Ma-tuoan-lin.)

302. In May—June a comet was visible in the morning.—(Ma-tuoan-lin.)

303. In April a comet was seen in the eastern heavens indicating (*i.e.*, pointing towards ?) ι and κ Ursæ Majoris.—(Ma-tuoan-lin.)

305 [i.] In September a comet was seen in the Pleiades.—(Ma-tuoan-lin.) Under the same date De Mailla places a comet near the Pole.—(*Hist. Gen.* iv. 248.) This is probably the comet of Ma-tuoan-lin, if we suppose him to speak of the *constellation* of the Pleiades in mistake for the *sidereal division* of the same name.—(Hind.)

305 [ii.] On November 22 a comet was seen in the square of Ursa Major.—(Ma-tuoan-lin.) Hind thinks this is the same as the preceding, but Pingré the contrary.

329. In August a comet appeared in the N.W. It approached very near to δ Sagittarii, and was visible for three weeks.—(Ma-tuoan-lin.)

336. On February 16 a comet was seen in the W. near ζ Andromedæ; it was also seen near *a* Arietis.—(De Mailla, iv. 349.) In Europe a comet of extraordinary magnitude was seen a year or more before the death of the Emperor Constantine, which happened on May 22, 337.—(Eutrop. *Hist. Rom.* x. 8.) Pingré and Hind consider these comets to be one and the same, in which case it must have been visible for fifteen months.

340. On March 25 a comet was seen in the neighbourhood of β Leonis.—(Ma-tuoan-lin; De Mailla, iv. 363.)

343. On December 9 a comet was seen. Its R.A. exceeded that of κ Virginis by 7°.—(Gaubil.)

350. On January 7 a comet with a tail 10° long, and extending westwards, was discovered near κ Virginis.—(Gaubil.)

358. On July 12 a comet appeared, but no position is given.—(Ma-tuoan-lin.)

363. In August—September a comet appeared near *a* and κ Virginis; it subsequently passed to near *a* Herculis and *a* Ophiuchi.—(De Mailla, iv. 413.) During the reign of Jovian, or towards the end of the year, comets are said to have been visible in the daytime.—(Ammian. Marcell. *Rer. Gest.* xxv.)

369. From the 2nd to the 7th moon an extraordinary star was visible in the western boundary of the circle of perpetual apparition. The 2nd moon commenced about March 25; the 7th about August 20.—(Hind.)

373 [i.] On March 9 a comet appeared. It traversed the following sidereal divisions, or its R.A. coincided with the following stars:—ε Aquarii, *a* Libræ, κ Virginis, *a* Virginis, γ Corvi, *a* Crateris, and ν Hydræ.—(Ma-tuoan-lin.) It is not impossible, however, that the comet did traverse these constellations, in which case the element must have been very small.

373 [ii.] On October 24 a comet appeared near *a* Herculis and *a* Ophiuchi.—(Ma-tuoan-lin.) Hind thinks that this was probably *Halley's comet*, which may have arrived at perihelion during the first week of November.

374. In January—February a comet was visible near μ^2 Scorpii and γ Sagittarii.—(De Mailla, iv. 437; Ma-tuoan-lin.) These positions would also apply to *Halley's comet* at this epoch, so it is at present uncertain whether this or the preceding was that body.—(Hind.)

375. A few days before the death of Valentinian, which occurred on November 17, comets were observed.—(Ammian. Marcell. xxx.)

389. In August (probably) a very splendid comet appeared. It rose in the N. at the hour of cock-crowing. Resembling the morning star it burned rather than shone, and ceased to exist in four weeks.—(Marcellin. *Chron.*) It appeared in the zodiacal region, but moving apparently on the left of the spectators, and rising and setting with the morning star it gradually advanced to Ursa Major and Minor. It lasted for about six weeks, and vanished near the centre of the former constellation.—(Philostorgius, *Epit. Hist. Eccles.* x. 9; Nicophoras, *Hist. Eccles.* xii. 37.)

390. On August 22 a comet was seen near α and β Geminorum. Passing the vicinity of β Leonis, ι, θ, and ϕ Ursæ Majoris, it entered the "square" of that constellation; on September 17 it arrived within the circle of perpetual apparition. Its tail was 100° long.—(Ma-tuoan-lin.) It lasted four weeks.—(Marcellin.) It is certain that two large comets appeared in two successive years, and what is equally remarkable, that they both followed nearly the same path from the zodiac to the pole; the first was seen, or at least recorded, only in Europe; the latter was seen both in Europe and China.—(Hind.)

392. A comet appeared.—(Couplet.)

395. A great comet appeared in August, which moved from ϵ Sagittarii towards β Aquarii, and α Equulei.—(De Mailla, iv. 496.)

400. On March 19 a comet 30° long appeared in the sidereal division θ Andromedæ. It rose to υ Cassiopeiæ and stopped to the W. of the circle of perpetual apparition; it entered the "square" of Ursa Major, and arrived near λ, μ, etc. In the next moon (commencing April 11) it passed by β Leonis to β and η Virginis.—(Ma-tuoan-lin; Gaubil.) The most terrible comet on record. Its form was that of a sword.—(Socrat. *Hist. Eccles.* vi. 6.)

401. In January a comet appeared near δ Cygni.—(De Mailla, iv. 57.)

402. In November—December an extraordinary star appeared to the W. of the region lying around β Leonis; two moons later it was nearer that star.—(Hind.) "It first appeared in the E. towards that part of the heavens where Cepheus and Cassiopeia shine. Passing then a little beyond the Great Bear, it overpowered by [the brilliancy of] its wandering hair the beauty of the stars of that constellation, till at length it languished, and finally dissipated itself in a very feeble flame."—(Claudian. *De Bell. Get.* xxvi. 228, *et seq*).

415 [i. and ii.] On June 24 two comets were observed near α Herculis and α Ophiuchi; passing by the former star they stopped to the N. of π and σ Scorpii.—(Ma-tuoan-lin.)

Probably this route applies to only one of the comets. From another Chinese chronicle it appears that on June 18, 416, two comets were visible. It is most unlikely that in two consecutive years in the same moon, and on the same day of the moon (Chinese reckoning), two pairs of comets should have appeared, so (as Pingré suggests) probably there was only one pair, one or other of the two historians having accelerated or retarded their appearance by one year.

418 [i.] On June 24 a comet was discovered in the middle of square of Ursa Major.—(Ma-tuoan-lin; "Cette comète diffère nécessairement de la suivante," Pingré.)

418 [ii.] "On July 19, towards the eighth hour of the day, the sun was so eclipsed that even the stars were visible. But at the same time that the sun was thus hid, a light, in the form of a cone, was seen in the sky; some ignorant people called it a comet, but in this light we saw nothing that announced a comet, for it was not terminated by a tail; it resembled the flame of a torch subsisting by itself without any star for its base. Its movement, too, was very different from that of comets. It was seen at first to the east of the equinoxes; after that, having passed through the last star in the Bear's tail (probably η Ursæ Majoris), it continued slowly its journey towards the west. Having thus traversed the heavens, it at length disappeared, having lasted more than four months. It first appeared about the middle of summer, and remained visible until nearly the end of autumn."—(Philostorg. xii. 8.)

In China the comet was seen on September 15 in Leo; it rose above δ or σ Leonis, and passed through the square of Ursa Major, the circle of perpetual apparition, and near ι and κ or λ and μ Ursæ Majoris.—(Ma-tuoan-lin.) It was first seen near δ Cygni, and was visible for eleven weeks.—(De Mailla, iv. 590.) Couplet states that it appeared at the end of November or the beginning of December. If for *appeared* we could read *disappeared*, the accounts would harmonize.

419. On February 17 a comet appeared in the west of the region lying around β Leonis.—(Ma-tuoan-lin.)

420 or 421. In May a comet was seen.—(Couplet.) In Europe a wonderful sign appeared in 421.—(Prosper. Tyron. *Chron.*) Was this the comet of the Chinese?

422 [i.] In March a star with a long white ray appeared for ten nights about the time of cock-crowing.—(*Chronicon Paschale.*) On March 16 it was near α and β Aquarii.—(Gaubil.)

422 [ii.] On December 18, a comet was seen near α and β Pegasi.—(Ma-tuoan-lin.)

423 [i.] On February 13 a comet was seen near γ Pegasi, and α Andromedæ.—(Ma-tuoan-lin.) A comet was frequently

seen before the death of the Emperor Honorius.—(Marcellin.) This event happened in August.

423 [ii.] On December 14, a comet was seen near α and β Libræ.—(Ma-tuoan-lin.)

432. A comet was seen near α and γ Leonis; passing in the vicinity of β Leonis it disappeared near α Boötis.—(Ma-tuoan-lin.) No moon given.

436. On June 21 a comet was seen near π Scorpii.—(Gaubil.)

442. On November 1 a comet, without a tail, was seen in the square of Ursa Major. It soon threw out a tail, and passing θ Ursæ Majoris, through Auriga, ρ and π Tauri, came to π Ceti, and γ, δ, μ Endami. It disappeared in winter.—(Ma-tuoan-lin.) It appeared in December and remained visible for several months.—(Marcellin; Idatius. *Episcop. Chron.*)

449. A comet appeared on November 11, near β Leonis.—(Ma-tuoan-lin.)

467. A comet resembling a trumpet was seen for periods of from ten to forty days in the evening sky.—(*Chron. Pasch.*; Theophanes, *Chronographia*, p. 99. Paris. 1655.)

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The annual meeting of the British Association, held at Newcastle-upon-Tyne, during the end of August and commencement of September, was one of the most successful in point of numbers and financial results of any that has been held for some years. The number of members actually attending amounted to 3356, of whom 1004 were ladies; and the total receipts reached the sum of £3600. From this the amount of £1750 has been granted for the purpose of carrying on scientific inquiries during the next year. In the inaugural address the president, Sir William Armstrong, recorded the most important scientific discoveries of the past year, and indicated the probable progress of science during the ensuing period. The history of locomotion was traced from the date when the pack-horses carried a load of three hundredweight from the coal-pit to the shipping place on the Tyne, down to the present time, when the locomotive engine conveys a load of 200 tons, at a cost of fuel scarcely exceeding that of the corn and hay which the original pack-horse consumed in conveying three hundredweight an equal distance.

The possible early exhaustion of our coal-mines, the source of

all our manufacturing wealth, was seriously considered. The facts that, theoretically, a pound of coal is, by its combustion, capable of producing sufficient mechanical energy to raise ten million of pounds one foot high—that in our best constructed steam-engines only one-tenth of that result is obtained—and that with our ordinary engines not even one-third of this lower amount is produced, were carefully considered; and the inference drawn that in our average steam-engines thirty times as much fuel is required as would be requisite with a perfectly-constructed heat-engine.

The possible substitution of some new source of motive power was considered; the fact that we cannot obtain mechanical energy without the consumption of materials demonstrated; and that no materials could possibly be so cheap as the coal from the earth and the oxygen of the air; the latter costing nothing, and every pound of coal rendering available two and a-half pounds of oxygen as a source of power. The reason that the materials of water cannot be regarded as a source of power is that the oxygen and hydrogen are already chemically combined, and require the expenditure of a great amount of chemical energy to effect their separation.

The time when we shall utilize the natural falls of water as sources of mechanical energy was regarded as inevitably, though slowly, approaching; and one great river was stated to develope at a single plunge sufficient power to carry on all the manufacturing operations of mankind, if they could be concentrated in its immediate neighbourhood.

The waste of coal in our ordinary households was a subject of regret. In warming by open fires we consume at least five times the amount of fuel requisite in a well-constructed stove; and as one pound of coal in an efficient steam-boiler is capable of evaporating one gallon or ten pounds of water, the amount of fuel wasted in our ordinary fires may be readily inferred.

The increase of temperature below the earth's surface, as measured at the Monkwearmouth colliery to a depth of 1800 feet, was stated to agree closely with that observed in other localities, namely, to be one degree Fahrenheit for every 60 feet. This, assuming the fusing point of subterranean minerals to be 3000°, would give a thickness to the earth's crust of about 34 miles, and would from the mere increase of temperature prevent the working of mines to as great a depth as 4000 feet.

In connection with the dynamical theory of heat, the circumstance that every degree of heat (Fahrenheit) in one pound of water is equivalent to 772 pounds lifted one foot high was stated, and also that these amounts of heat and power were reciprocally convertible into one another. This led to the consideration of the explosive force of gunpowder, which first appears as heat and then takes the form of mechanical power, communicated chiefly to the shot; which force is reconverted into heat when the motion of the shot is arrested in striking an object.

After alluding to the resolutions of Mr. Tyndall on radiant heat, which have been described in our previous volumes, Sir W. Armstrong advocated strongly the introduction of the metric system of

weights and measures, and the centigrade division of the thermometer, and recommended the Association to exclude all other standards from their future publications; and concluded by a consideration of, and a qualified assent to, the Darwinian theory regarding the origin of species.

Many of the topics of the papers read in the different sections of the Association have been already mooted in the different scientific societies, and have been duly chronicled in our pages. Among the most interesting of those not noticed may be mentioned that of Mr. A. Claudet on the refractive power of the eye, by which objects that are situated in reality somewhat behind us appear as if situated to the left or right; or, in other words, that objects are pictured in the retina which are included in an angle much larger than half the sphere of which the observer is the centre.

From the refractive power of the cornea, rays passing through it are more and more refracted in proportion to the angle at which they strike its surface; the only objects seen in their true position being those whose rays enter the eye perpendicularly to its surface; rays entering at an angle of 90° are refracted 10°, and appear to come at an angle of 80°.

Some curious illusions result from this law. I may suggest the following experiment. Connect two lights placed at some yards distance from each other by a strained thread, on placing the face over the centre of the thread, and looking at right angles to it, both lights are seen somewhat in advance of the body, as if forming an angle of 160°, and if the observer turns his back on the thread and walks away from it, both lights remain visible, so long as the angle formed by them does not exceed 200°; hence we are really enabled to see behind us whilst looking straight in front.

Mr. Claudet called attention to another effect of this phenomenon. That on placing ourselves so that the sun is on one hand and our shadow on the other, the sun and shadow do not appear connected in one line, but that they are bent to an angle of 160°, and are both seen a little before us. The intellectual observer of these phenomena need hardly be reminded that the head should not be turned to either side during these experiments.

The paradoxical and apparently impossible action of Giffard's injector, employed instead of a feed pump in charging steam-engine boilers, was illustrated in a remarkable manner by the Abbé Moigno, with M.M. Bourdon and Salleron's "Injector of Solids."

Giffard's injector consists of three tubes united at one point: one of these brings the supply of water for the boiler from any convenient source; the second is for the purpose of conveying the water into the boiler, and opens below the level of the liquid in that vessel; the third brings a jet of steam from the upper part of the boiler. This jet of steam has the power of injecting a constant supply of water into the boiler, and so obviating altogether the necessity for a feed pump, and, apparently impossible as it may appear, not only has the steam power to inject water into its own boiler, but it is capable of feeding another boiler in which the steam has a much higher pressure than itself. MM. Bourdon and

Salleron's Injector of Solids, which is capable of rendering this action visible by means of solid bodies, consists of two air vessels, with a communicating tube capable of being opened or closed at the will of the experimenter. One of these vessels is made of glass, and furnished with an aperture closed by a valve opening inwards. The other has a small air-gun proceeding from it, the barrel of which is directed against the opening in the first vessel. On condensing air into the two receivers, it is found that, even when four atmospheres are condensed into the glass vessel, and only two in that connected with the air-gun, the bullet driven by the latter has power to open the valve closed by the pressure of four atmospheres and enter the glass receiver.

The paper read by Dr. Embleton on the Anatomy of a Chimpanzee strongly corroborated the facts brought forward by Professor Huxley and Mr. Marshall, that the brain of this animal differs only in degree—that is, in the smaller size and extent of its parts—from that of man; and that with this difference essentially the same structures, without any exception, exist in both brains.

Dr. Crawford maintained in a subsequent paper that the consideration of the material structure of the brain was of far less value than a consideration of its working or living action, and that probably there exist subtle differences between the brain of man and those of the lower animals that anatomy has not, and probably never will, detect.

Thus the brain of the wolf is anatomically the same as that of the dog, one being an untamable glutton, the other the friend and companion of man. The Australian savages tame the young of the wild-dogs, and use them in the chase, whereas the young of the wolf are not capable of complete or useful domestication. Again, the hog, with its low organized brain, is equal in intelligence to the most anthropoid monkey. The sheep and the goat have brains identical in structure, the one being a stupid, the other an intelligent animal.

Among the more singular new instruments exhibited at the meeting must be mentioned M. Soleil's Tenebroscope, for demonstrating the invisibility of light; this was shown and described by the Abbé Moigno. It illustrates the fact well-known to scientific observers that rays of light are invisible except the eye is so situated as to receive them either directly or as reflected from surrounding objects.

This is decisively shown when a beam of sunlight is admitted into an otherwise perfectly dark chamber, and received on a piece of black velvet or other non-reflective surface; when the whole chamber remains in perfect darkness, and the ray of light itself is perfectly invisible except that small portion of it which is reflected from the atoms of dust floating in the air. On powdering some small dust in the course of the beam, or by pouring a shower of water across it from a small watering can, it becomes immediately visible; and the chamber itself may be instantly illuminated by receiving the beam on any reflective surface. M. Soleil's Tenebroscope consists of a tube closed at one end, the other being open to

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admit of being looked into. The interior is blackened, and there is an opening in the side to admit a strong light to pass across the tube. When looked into from the end, the tube is perfectly dark despite of the light passing across it; but on raising a small white ball into the course of the rays of light, they instantly become visible from being reflected so as to enter the eye of the observer.

NOTES AND MEMORANDA.

SUGAR FROM SERPENTS' SKINS.—M. S. de Luca obtains small quantities of sugar by chemical transformation of a substance existing in the skin of serpents, and which is isomeric with vegetable cellulose. The existence of this substance under such circumstances affords another connecting link between animal and vegetable organic bodies.

POISONOUS EFFECTS OF THALLIUM.—M. Lamy calls the attention of the French Academy to the poisonous properties of thallium, to which he ascribes pain and lassitude chiefly in the lower members, which he experienced while experimenting on that metal and its compounds. He dissolved five grammes of sulphate of thallium in milk, and offered it to two puppies, who tasted it and left it alone. Two fowls, six ducks, and a moderate-sized dog obtained accidental access to the milk. The dog was soon taken ill with sharp pains, and his hind-quarters were partially paralyzed, after exhibiting convulsive movements. Iodide of potassium was administered as an antidote, but the animal died in sixty-four hours, having been affected neither by vomiting nor alvine dejections. In the evening after the milk had been swallowed one fowl and six ducks died. Four days afterwards the two puppies died. All the creatures suffered paralysis of their lower limbs. The second fowl was killed on the eighth day, having for three days been in a bad state, and unable to stretch its neck sufficiently to pick up food.

THE AUGUST METEORS.—M. Coulvier-Gravier has a short paper on this subject in *Comptes Rendus*. He says that "in August, 1861, he pointed out the year 1858 as terminating the descending period, since 1848, when the phenomena were at their height, and on the 9th, 10th, and 11th August 110 shooting stars appeared per hour. In 1858 the number had descended to 39·3, while in August, 1863, he noticed 66·7 per hour." He adds that we may soon expect the August showers to re-appear in all their magnificence.

BREAD FROM POMPEII.—In August last year a baker's oven was discovered in Pompeii, closed with an iron door, and containing eighty-one loaves of a brownish colour. M. S. de Luca, who examined some of this bread, and reported to the French Academy, found that the loaves still contained some moisture, which they parted with at 110° to 120° C. The central portion contained about 23 per cent. of water and the exterior only 19 to 21 per cent. The quantity of carbon diminished from the circumference to the centre, while the hydrogen followed an opposite rule; thus it would seem that the decomposition took place very slowly, and was not affected by sudden and strong heat. The central parts were least affected, and contained the largest quantity of the elements of nutrition.

POISONING BY NITRO-BENZOLE.—*The Proceedings of the Royal Society*, No. 56, contain an important paper by Dr. Letheby on the above subject. It appears that if a dose of nitro-benzole be not too large, its poisonous action will not be immediately apparent, but it may "destroy life by a lingering illness, which shall not only defy the skill of the physician, but shall also baffle the researches of the jurist." After death the blood of animals so killed is black and turbid, and the large organs congested, and no nitro-benzole can be discovered, if sufficient time has elapsed, as it will then be converted into aniline. Such facts show the necessity of having medical men well trained in chemistry. Aniline produces symptoms very similar to nitro-benzole. The conversion of the latter into the

former takes place in a dead stomach, or by contact with putrid flesh for several hours.

Causes of Coagulation of Blood.—Professor Joseph Lister observes, in the Croonian Lecture, which details elaborate experiments, "that the coagulation of the blood is in no degree connected with the evolution of ammonia any more than with the influence of oxygen or of rest. The real cause of the coagulation of the blood when shed from the body is the influence exerted upon it by ordinary matter, the contact of which for a very brief period effects a change in the blood, inducing a mutual reaction between its solid and fluid constituents, in which the corpuscles impart to the liquor sanguinis a disposition to coagulate.—*Proceedings of the Royal Society.*

Atmolysis.—Professor Graham gives this name to operations of *dialysis* conducted with gases, the molecules of which pass through tubes of unglazed earthenware, or plates of graphite, with unequal velocities, so that a separation, more or less complete, of mixed gases, can be effected by this means. He says, "the most remarkable effects of separation are produced by means of the *tube atmolyser*. This is simply a narrow tube of unglazed earthenware, such as a tobacco-pipe stem, two feet in length, which is placed within a shorter tube of glass, and secured in its position by corks, so as to appear like a Liebig's condenser. The glass tube is placed in communication with an air-pump, and the annular space between the two tubes maintained as nearly vacuous as possible. Air, or any other mixed gas, is then allowed to flow in a stream along the clay tube, and collected as it issues. . . . In the gas collected, the denser constituent is thus concentrated in an arithmetical ratio, while the volume of the gas is reduced in a geometrical ratio. In one experiment the proportion of oxygen in the air, after traversing the atmolyser, was increased to 24·5 per cent., or 16·7 upon 100 oxygen originally present."—*Proceedings of the Royal Society*, No. 56.

Ross's New Compressorium.—Microscopists who have suffered the inconvenience inseparable from ordinary forms given to a compressorium, will thank us for calling their attention to an entirely new pattern devised by Mr. Ross. It consists of a stout plate of brass about three inches long, having in its centre a piece of glass like the bottom of a live box. This piece of glass is set in a frame which slides in and out, so that it can be removed for the convenience of preparing any object upon it, under water if desirable. The upper moveable part, attached to a screw motion, is admirable for simplicity and efficiency. At one end of the brass plate, which forms the bed of the instrument, is an upright piece of brass, accurately grooved so as to receive a vertical plate, to which a downward motion is given by a single fine screw, surrounded by a spiral spring, which elevates the plate as soon as the screw pressure is removed, by turning the milled head the reverse way. The vertical plate carries an arm precisely at right angles to its own plane, and terminating in a square frame capable of receiving very thin or somewhat thicker glass according to desire. This is the upper part of the compressorium, and the exact amount of pressure required is completely under command by the motion of a single screw. The arm has likewise a horizontal motion, so that the upper glass, plate can be turned completely off the lower one. Should the thin upper glass be broken, it can be instantly replaced, as no cement is required. It is merely needful to remove the fragments, and slip a fresh glass in. We do not know any compressorium that is at once so accurate and so easily used. If required, a duplicate frame, carrying a thin bottom glass, can be obtained, and it would be very easy to contrive a support, as in the pattern of M. Quatrefages, by which either side of the object could be viewed. It often happens that on account of the trouble of an ordinary compressorium, a microscopist simply uses a slide and a piece of covering glass, and finds when too late that an exact means of regulating the pressure would have been desirable. With Mr. Ross's new pattern the convenience is so great that it should always be employed if there is a chance of the screw motion being advantageous.

Earthquakes at Rhodes.—M. Jouanin, *gerant* of the French Vice-Consulate, gives an account in *Cosmos* of the disturbances in that island since 1860; and he likewise mentions a severe shock which occurred on 12th October, 1856, accompanied by vertical oscillations. In the year 1860 earthquakes occurred

in January, February, and June; in 1861, they occurred in May, June, July, and August, in the Isle of Niceros; and in May, 1862, at Marmoritza, a part of Anatolia, twenty-five miles from Rhodes. In June, July, and August, 1862, Rhodes itself experienced shocks, which were repeated twice in March, and three times in April, 1863. On the 22nd April the shocks were violent, and a gyratory motion felt. The barometer sank considerably between four o'clock in the afternoon of the 21st and the same hour on the 22nd, six and a half hours before the shock. A violent north-west wind which had been previously blowing, stopped during the earthquake, and in a few minutes regained its force. In 1856 the south-west part of the island chiefly suffered; but in April, 1863, the south-east part was most affected. In the village of Mossari not a house was left, and 130 out of 200 inhabitants perished. The shock was felt simultaneously at Rhodes, Smryna, and Alexandria, and on the coasts of Syria and Asia Minor. The adjacent islands, likewise, felt it, and two ships passing between Cussos and Scarpanthos were violently affected. The writer states that from the beginning of 1863 the sea did not return to its usual level; two days before the earthquake it was lower than ever, but after the shock it regained the old level, and sometimes went beyond it. After the great shock five lesser shocks occurred in April, and four in May.

Bolides at Rhodes and Dust-shower.—The writer of the preceding mentions a magnificent bolide that burst over the island on 12th March, 1863, at one a.m. It moved from east to west, exploded like a bomb, and scattered fragments in all directions. After its disappearance two fresh detonations were heard, followed by prolonged humming. The sky was brilliantly lit up, and the light lasted some minutes after the passage of the meteor. A similar bolide appeared on the 17th March, at seven p.m., but it was smaller and made no explosion. In the night of the 28th and 29th March a strong south-west wind brought a quantity of yellowish dust, which fell in showers and covered all the vegetation.

Material for Photographic Lenses.—M. Gaudin states that rock-crystal is the best material for photographic lenses, on account of its permitting the passage of the largest quantity of actinic rays. The editor of *Cosmos* observes:—"It is evident that a transparent substance which gives a passage of the greatest quantity of the violet and extra violet rays, would be best adapted to the construction of active lenses."

Solid Matter in Rain.—M. Robinet states that the rain falling in Paris holds certain solids in solution, the quantity being usually, though not always, greater after drought. As a rule the quantity of solid matter diminishes as the shower is prolonged. Paris rain contains chiefly sulphate of lime, and an organic matter of which little is known. The sulphate of lime is sometimes present to the extent of twenty grammes in a cubic metre. He adds, that rain-water froths on agitation more than other water, and that in Paris it yields red tints, with nitrate of silver, and deposits a garnet-coloured precipitate.—*Comptes Rendus*, 7th Sept., 1863.

The Bouquet of Wine.—M. Maumené recently addressed a letter to the French Academy, in which he states that the flavour of certain wines can be obtained by adding to ordinary wine a few drops of a liquid composed as follows:—He distils sixty litres of fresh wine lees, mixed with water, in a chloride of calcium bath, and as soon as the fluid he obtains emits an odour of wine, he adds a cubic centimetre of essence of pears, one volume of Valerian-amylic ether, and six volumes of alcohol at 36° strength. If too much is added the flavour of the pear becomes apparent. By adding two drops of butyric ether the flavour of good Vin de Bouzy is imitated. He says those ethers are most successful in which the acid and the base have both high equivalents.

The Natterjack in Lancashire.—Mr. Wm. Tyrer, of Leamington, alluding to the recent paper by Mr. Couch, informs us that, "The Natterjack is very abundant in South Lancashire in all the ditches, in those parts near the coast, and also in pools of water among the sandhills. It makes a very peculiar noise in the summer evenings, and in the parish of North Meols is known by the name of Meols' Organ."

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SLIMONIA (Pterygotus) ACUMINATA, Salter. Sp.
Upper Ludlow rock, Lesmahagow. ¼ natural size. —From a specimen in the British Museum.